73 AMATEUR RADIO

International Edition

JANUARY 1989
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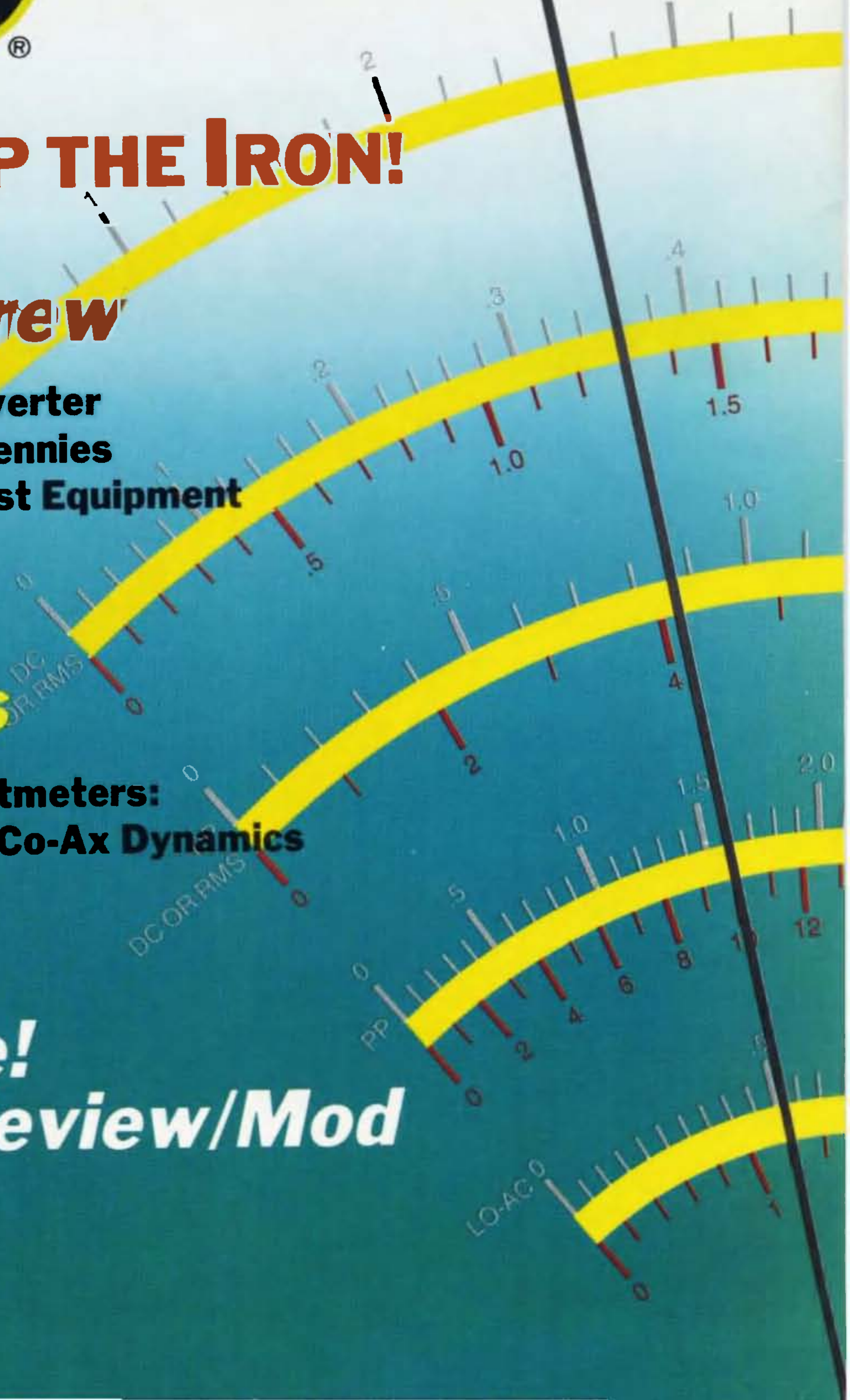

WARM UP THE IRON!

Home-brew

220-MHz Transverter
Attenuator for pennies
More 10 GHz Test Equipment
Meter Mods

Reviews

Tale of Two Wattmeters:
Bird 4381 and Co-Ax Dynamics
Cheap CAD

Must See! VisiTel Review/Mod

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Welcome, Newcomers!

This month's column is devoted to a different kind of newcomer—the home-brewer who has not yet published his or her project.

Is Home-brew Really Dead?

Some hams seem to think so—or at least they think that this activity has shrunk to the domain of a small core of dedicated hackers and techno-peasants. These hams poured forth with all the "logical" reasons. They cited, for example, the increased availability of sophisticated commercial equipment, the growing "Grab-It-Now" ethic in our (American) society, and the influx of less technically-oriented members into our ranks because of relaxed licensing requirements. Do we now sound the death knell for home-brewing?

It's In The Cards

Our reader feedback responses fly in the face of the above reasoning.

Each month, I read through the stack of monthly reader feedback cards. (These are found in between the pages of the magazine.) On these, we ask the readers to rate the editorial content of the issue on a three-level scale of "Great," "OK," and "No Way." Below the rating grid, we ask in what areas they would like to see more, and see less. The responses ranged from DC to daylight, but one item came up through the noise floor loud and clear: MORE SIMPLE CONSTRUCTION ARTICLES.

Recently, we began sending our readers, along with their subscription mailings, a more detailed satisfaction survey. *Three out of four* of the returns echo the same message: MORE SIMPLE CONSTRUCTION ARTICLES.

Many of these are not just polite, offhand requests. They are out-and-out demands, scrawled in bright red caps across the card. It's clear to us the readership *clamors* for the nuts-and-bolts of this hobby; the simple tale that tells how to build a simple project; the "this is what I did and how I did it."

What To Do?

Since so many of you *want* to build, then a goodly number of you *have already built* one or more projects. Yet we receive relatively few manuscripts on light home-brew projects despite many lures: showing off your project to over 100,000 readers, getting paid quite well for it, having a nice feather to stuff in your resume (for you are now an "authority" on the subject), and even enjoying the warm, fuzzy feeling of carrying out an important part of our mandate set forth by the FCC, that of furthering and disseminating the state of the art. Why is it that so many of those who design and build don't put their brainchilds to paper?

It's true some home-brewers simply can't be bothered. Yet many I've talked to really want to write, but are convinced they can't—even those who have never tried! The next section attempts to dispel common confidence-blockers.

The Four Fallacies

Fallacy #1: "I don't have the talent to write."
Reality: This statement assumes that writing and design and building are fundamentally different skills. Actually, they're very closely related!

A home-brewer usually systematically executes an idea—he sketches out the project in block diagram form, then works out the circuit details within each block, then interfaces the circuit blocks. He first works out the plan generally, and then in gradually greater detail.

Effective writing is no different! You first sketch out a general three-point outline, in which you include sub-outline points (see below), and then you fill in the details under each outline point.

Introduction
- What led to the birth of this idea?
- What are its advantages?

Main Body of Text
- Circuit theory and description
- Parts List
- Where to obtain parts
- Step-by-step construction sequence
- Construction caveats

Conclusion
- Summarize the project, highlighting its advantages.

Fallacy #2: "My project is too simple or too left-field for anyone to want to bother with it."
Reality: The simplest projects are often the best! Remember, too, the project the veteran home-brewer passes over is often right up the greenhorn's alley. *73* strives to present a range of simple-to-challenging home-brew projects.

The readers, too, always surprise us. Many so-called marginal projects became popular beyond our wildest imaginings. Woe to us in Editorial if we ever stop surveying the readership, thinking we "really know" what the reader wants!

Finally, our readers often read through something simple and short, even if they have no immediate plans to build it. How often have you wanted to find an article published years back? We run a thriving article reprint business here.

Fallacy #3: "My schematics, parts placement diagrams, etc., are too poorly drawn to appear in a magazine."
Reality: You may have noticed a consistency in the style of our printed figures—they're the work of our excellent draftsman. Bill's been with *73* from the beginning—there's not much he hasn't seen!

Fallacy #4: "No editor will wade through my awful grammar and spelling."
Reality: Often, it's not as bad as you think. Even if it *is*, you're in good company—many noted writers, such as Ernest Hemingway, were terrible spellers. Most had editors, like you do—us! Fortunately, there are many checks, both on the author's and editor's side.

First, write or call for, or download from CompuServe, our Writer's Guide.[1] By following the Guide and the outline above, we can more easily estimate your meaning through context. Be sure to clearly state your objective both in the cover letter and in the Introduction of the article. If the idea is strong, we go to great lengths to show it the light of day.

Second, more and more authors have access to microcomputers with enough memory to run spelling checker programs. We have been using WordStar's sophisticated spelling checker for many months, and we will be using, by this printing, "Grammatik III"—a program that analyzes text for several dozen different common grammatical problems.

Third, on particularly confusing points, we call you for on-the-spot clarification. (Be sure to include a phone number on your cover letter!)

Fourth, when your article is scheduled and prepared for a given month, we send you copies of the final edit for your review. These are called Author's Proofs. *Rarely* are there problems at this stage. Nonetheless, conscientious authors read these carefully in the event that a major fault or two remain.

Finally, you may want to team up with a writer. It can be a very effective, even synergistic, relationship. Some of our authors do this, with wonderful results. The article payment split two ways is often more than offset by the time saved and the enjoyment.

Let's Hear From You

It should be clear that most writing problems are imagined, and the real problems are most often very manageable. If doubts remain, call and talk with us—we're friendly and receptive, and we're here for you. Ditto if you want to home-brew and write, but are not sure where to start. We have a stack of letters from readers looking for a myriad of different designs.

Remember: *If you can design or build it, you can effectively write about it*—and everyone will be the richer for it!

...de NS1B

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[1] *The* 73 Magazine *Writer's Guide is available on CompuServe's HamNet, Library 0, filename* "73WRIT"

QRM

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Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. A premium will be paid for accepted articles that have been submitted electronically (CompuServe ppn 70310,775 or MCI Mail "WGEPUB") or on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their social security number with submitted manuscripts.

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Contract: Reading this binds all you electronikers out there in Hamdom to perform the following: 1) Send for our Writer's Guide. 2) Following the instructions therein, apply at least one of your brainchilds to film, paper, and/or diskette. 3) Send to us in article form for everyone to benefit. No cavilling about how you can't write—everyone can! You'll feel better, and you even get paid.

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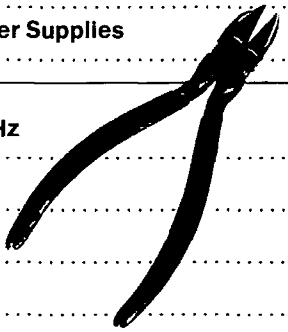


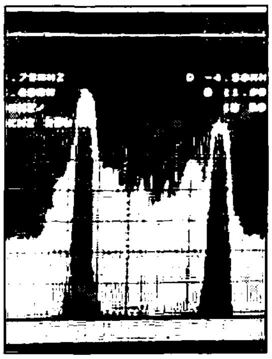
HOME-BREW

REVIEWS

BOOK REVIEWS

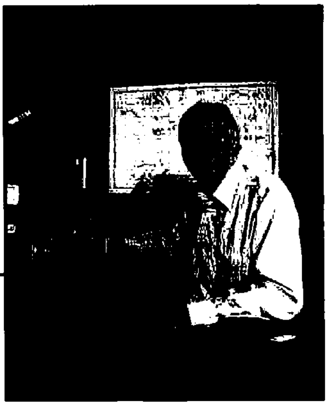
DEPARTMENTS

FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.



Cover by Deborah Smith

Number 2 on your Feedback card



NEVER SAY DIE

Wayne Green W2NSD/1

Do We Fight Or Give Up?

Amateur radio has what growingly appears to be a terminal illness. What can we—what should we—do about it? We can try to pretend there's no real problem—ignoring the loss of new hams and our frequencies. We can give up. After all, there are plenty of other interesting hobbies—right?

Almost 30% of us have paid our dues to the ARRL—what more could possibly be expected of us? What can one person do that would make any difference?

The fact is, if you want to, you can have a profound influence—and not only toward saving amateur radio. In the process, you might be able to help solve some of America's growing problems. it's never going to happen if you wait for someone else to do it. Are we hams a bunch of wimps, willing to let our hobby die without a fight?

Yes, I know, hams are wimps when shown on TV. The ham on ALF is a megawimp, for example. But I haven't seen one single copy of a letter to the network, the producers or the show's advertisers protesting this outrageous defamation of our character. Are we wimps?

What are our resources? Well, we have about 400,000 reputedly alive and semi-alive licensed hams. About 50% are even remotely active. Now, if these 200,000 of us pooled our efforts, we'd mow 'em down. An average investment of $100 per ham would provide $20,000,000 to get some clout in Congress. $20 million toward re-election campaigns buys tons of clout in Washington. A $100 campaign donation buys about four thousand times the attention of a letter.

Just flexing our political muscles isn't going to save our hobby. At best it can stave off more frequency losses and give us a chance to start rebuilding the infrastructure the League almost totally destroyed 25 years ago. This was the network of thousands of school radio clubs that provided us with 80% of our newcomers—our youngsters. These clubs were virtually wiped out in 1963 by the ARRL's self-promoting Incentive Licensing proposal.

It's their thousands of school radio clubs that have fueled Japan's ability to provide their country with the engineers, technicians, and scientists with which they've destroyed our consumer electronic industry. If you read at all, you know that twenty years ago we produced virtually 100% of our consumer electronic equipment. Today, we make less than 5% of it.

Just Say No To'em

Yes, I know I've been on you about dieting and smoking—and I should be on you about alcohol too. I often throw guilt around about your lousy reading habits. Okay, I'm a nag. But I'm nagging for your benefit—and for amateur radio. Other than having you thank me at hamfests for having pushed you to slim down, exercise (get out there and walk every day), stop your drug habits (alcohol and nicotine—both of which shorten your life, make things miserable for others and waste money)—I don't get a lot of benefits.

Now, let's discuss drugs. I see you slurping 807s at hamfests. And don't think I don't see you trying to hide your cigarette as you try to sneak by the *73* booth with me glowering at you.

There's a lot of political excitement over our drug problems in America. And they're serious, I agree. But when we kill 30 times as many Americans with booze (and that mainly means beer) as we do with cocaine, heroin and crack combined, let's put this into proportion. Even worse is nicotine, that kills 60 times as many. I've lost a lot of friends to cigarettes and a few to alcohol, but none personally to drugs.

The only results of the war on drugs so far have been an escalating cost to the government and a steadily dropping of drug prices as ever more are smuggled in.

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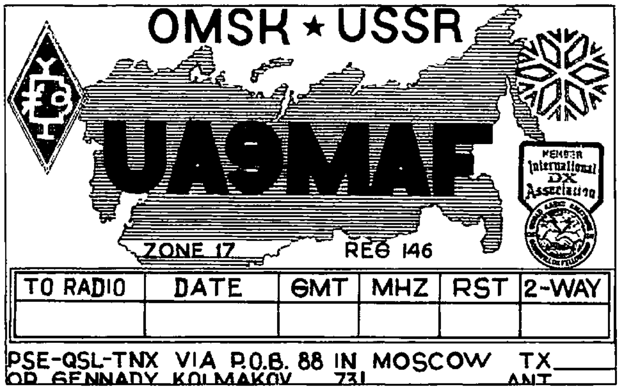

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, 70 Rte. 202 N., Peterborough NH 03458, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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The enormous profits involved assure that there are an unlimited number of potential criminals. Any "war" on drugs is un-winable.

Indeed, my proposed solution to America's drug problem would be to legalize drugs and sell all of them through state drug stores. And that means beer and cigarettes as well as cocaine and heroin. Further, I'd prohibit all advertising of these destructive products.

By controlling the sale through state stores we'd take the profits out of the drug industry. This would tend to stop the present pyramid sales system where addicts have to entrap new users in order to pay for their needs.

Once you take the profits out of drugs, you'll get crime out of the business. This could eliminate about 75% of today's crime for starters. And without the pressures of advertising and crime to get more customers, our educational programs to keep youngsters from trying drugs might take hold.

The barrage of ads pushing beer and cigarettes glamorizes these destructive drugs. Nicotine, being so viciously addictive, and our worst killer, has been difficult to fight. But even with the advertising and government subsidies (which are obvious government approval), tobacco use has been dropping.

Yes, I realize that the above is idealistic and that we live in a practical world where idealism doesn't pay off. If I were a crime boss I'd spend whatever it takes in congress to make sure that drugs are not legalized. This cash pressure makes it difficult for us voters to know whether a legislator has been bought or is driven by other convictions. We should remember that money will usually overcome even the most strongly held congressional convictions.

Newspapers, magazines, radio, and TV will fight every attempt to eliminate drug advertising—as will the bottlers, tobacco companies, distributors and retailers. We're talking a lot of campaign donations, so unless we get more information on who's paying off whom in Congress, we're going to keep killing hundreds of thousands of people a year with alcohol and nicotine.

Which is why I started by pointing out the value of investing in your legislators. Not even 200,000 of us can match the resources of the crime syndicates, so we probably can't do much about solving the stupid drug "war." But we sure can tip the balance when it comes to our losing more ham bands—at least until we can get amateur radio growing again.

Business Encroachment

The commercial pressures for our bands are growing rapidly. Communications is exploding and not just with fiber optics—it also means more radio spectrum will be needed.

UPS needs a system of high speed digital communications that will allow them to be in constant touch with every truck so they'll know at any instant where any package is. This means microwave satellite links, UHF repeaters, and frequencies. More and more businesses are going to demand the same depth of service and a bunch of aging old timers idling away what's left of their lives on 2m isn't going to stop progress for long.

High Definition TV, America's last opportunity to get back into consumer electronics, is going to need at least twice the bandwidth presently used. Do you think our present level of ham activity at 900 MHz is going to keep HDTV and other new services from being considered there?

The FCC is under strong pressure to open more UHF TV channels to make room for thousands more one watt TV translators—to extend TV into more small towns. And wait until we start with interactive TV!

Okay, I've proposed a step toward our holding our bands until we can get ham radio growing again. But without a practical plan for growth, we'll be spinning our wheels. Unless we come up with something good—and quickly—we're dead ducks.

Young Blood Needed

The ARRL has suggested working on getting more retired people licensed. Well, that's great for the retired—such an interest could keep them alive longer by giving them something interesting to do and helping them find new friends. I've no complaint with that.

But this isn't going to have any significant effect on our growth. Our growth has been a net 1% for the last five years—and that's if you don't admit that anyone has died. Even ten times that growth is too little. We need twenty to fifty times our present "growth."

I've mentioned that the number of new hams has been dwindling. The FCC figures show that they've dropped by 54% in the last four years! It's almost enough to worry a sensitive person. We need to get youngsters into the hobby. We even need to find a way to attract Black, Hispanic, and other minority youngsters. Yes, I have some suggestions.

I've already written too often, about the need for our ham clubs to work with their local schools to get school radio clubs restarted. This is happening in a few areas. I'd love to see some articles and pictures from clubs who have been successful in this. I know you're out there—you tell me about it at hamfests—but until you write about it, it's a well-kept secret.

We'd have more of a chance of attracting youngsters to amateur radio if our educational system hadn't self-destructed so badly. Part of the blame for this lies with TV, part with parents, part with teachers and their unions, and part with Dr. Spock and his let-the-kids-do-what-they-want philosophy that was fervently embraced by the yuppie generation. That's a lot of problems to solve.

Add to those the problems facing lower income families—the trap of welfare—the fast track of drug profits—the street gangs that entrap virtually every inner city youngster. If we're ever going to turn these kids into engineers, we've got a long row to hoe. We have to get the profits out of drugs, offer something more attractive than welfare as a way of family life, and replace street gangs with something more beneficial to the kids—and to society.

That's a lot to accomplish. Well, we've got 200,000 active hams, so we should be able to do a lot. And we can, if we want to. It depends on what's more important to you.

It seemed to me that we have three major problems with education. First, the present educational system hasn't encouraged teachers to make their material exciting to the students. I proposed to the new president of RPI, Dr. Roland Schmitt, and to the dean of the School of Management, Robert Hawkins, that Rensselaer initiate a study of teaching technology in order to find out what is working best in teaching productivity today. I was pleased that Dr. Schmitt has just announced the formation of a Center for Innovative Undergraduate Education. This will be "devoted to improving the quality and effectiveness of undergraduate education through innovative approaches in curriculum and course development, explorations of the role of technology in education, and partnerships that support science and mathematics education in primary and secondary schools." See *Electronic Engineering Times* 10/3/88 p.29 for the story.

I'm working through my *Congressional Technology Newsletter* to put pressure on Congress to consider my solution to the drug problem. The present demagoguery, with threats to bring in the military and embargo products from drug supplier countries isn't going to work. Our military is neither trained nor equipped for drug interdiction. And we don't want to retrain and re-equip them for this, since that would leave us without the strength to discourage the USSR from further adventurism.

The welfare mess? Of course I've got a good solution to this one—but not one that would work without solving the drug problem too. Here I looked for a similar situation that another country had solved successfully. There was a close parallel with Israel, to where millions of virtually destitute people suddenly immigrated. Israel put'em into kibbutzes where they were able to work together cooperatively. They farmed and started small manufacturing businesses—and were very successful at it. Their system for educating their children made them part of their communities and kept them from forming gangs. As the kibbutzes became successful they spun off entrepreneurs who started their own businesses.

I believe that we could get American businesses to buy shares in New American Communities that would encourage welfare families to move from the inner-city ghettos to farms. Surveys show that an overwhelming number of welfare families really want to work, but the system prevents it. I say it's time to change the system and give these people a chance to succeed. I also believe we should do everything we can to get their kids interested in setting up ham stations in every New American Community.

As part of the holding action to keep amateur radio from getting gutted while we're rebuilding our infrastructure, I've formed a National Industry Advisory Committee (NIAC) to work with the FCC Commissioners. Amateur radio

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QRX . . .

EDITED BY BRYAN HASTINGS NS1B

Space Station Mobile!

There are, or soon will be, amateur radio operations from the Soviet space station *Mir*! Reliable Western European sources report that a 2 Watt 2 meter FM transceiver has been placed aboard *Mir*, possibly during a recent resupply mission. Sources also indicate that the crew has placed a ¼-wavelength ground plane antenna on the outer surface of the space station. The split frequency is not yet known.

The *Mir* cosmonauts have the callsign U1MIR. Amateur operations were planned to begin the first week of November.

A meeting was to be held in Moscow on Friday, 28 October, with Soviet authorities, to resolve schedule and frequency issues related to this activity.

Reports indicate that U1MIR will most probably be active for the duration of the stay of the current cosmonaut team aboard *Mir*. When a relief crew replaces the current team of cosmonauts, a 10 Watt 2 meter FM transceiver will likely be placed aboard *Mir* and the callsign of the operation changed to U0MIR.

Observers feel that operations from U1MIR/U0MIR will most likely involve international amateur radio contacts. Watch AMSAT news service bulletins for late-breaking details.

November March

Hams in Omaha, Nebraska, called on amateurs nationwide to join with them in the Save 220 MHz Protest Marches planned for Sunday, 27 November. According to John Gebuhr WB0CMC, one of the march organizers, the march's aim was to demonstrate the anger of radio amateurs over the FCC's decision to reallocate 220–222 MHz to land mobile business interests. The Omaha demonstration will have taken place in front of the federal court building, and hopefully in front of FCC facilities in those cities that have them, especially in Washington, DC. WB0CMC noted that television news organizations are always pressed to find newsworthy stories on this particular weekend, which is one of the reasons it was chosen.

It's interesting to note that this protest originated not in one of the areas where the 220 band is most heavily crowded, but in a part of the nation where the rapid growth on the band is just beginning.

Missile Restriction

The United States Army is testing a new missile guidance system in northern Alabama that will temporarily heavily restrict amateur operations on the 70 cm band in that area. The ARS shares the 420–450 MHz band with the government. Amateurs in Alabama are being requested to observe quiet hours up to five hours a day. As a result, at least three voice repeaters in Huntsville and Florence are off the air. Packet, fast-scan amateur television, and amateur satellite operations are among the other modes FOG-M affects. The hams are requested to make the job of the Army easier, and avoid further restrictions, by staying off the air.

According to David Black KB4KCH, a TV news reporter in Birmingham, the system is a new Fiber Optic Guided Missile (FOG-M), now under development at the Redstone Arsenal in Huntsville. Testing of FOG-M involves low-power airborne sensors. 70 cm amateur band use is only for testing purposes and will not be used when the system is actually deployed. The Army expects the tests to last into late December.

There have been mixed reactions about this from the affected amateur community. While most amateurs in the affected area say they are happy to cooperate, some claim that the Army has plenty of its own spectrum in which they could perform FOG-M experiments.

International News Snippets

Canada: The Radio Society of Ontario (RSO) has decided to disband. In announcing the decision following a special meeting on 15 October, RSO officials noted that many former RSO people were responsible for the creation of Canada's two National Amateur Radio Organizations—CRRL and CARF—and that these two groups were serving the needs of Ontario amateurs quite well. The matter will now be turned over to the RSO's solicitor (attorney) who will handle the legal aspects of disbanding and the distribution of the RSO's assets. These include the Clifford Marsh Amateur of the Year Award, which will be turned to CARF; and the Keith Russel and Rusty Brennan Field Day Awards which the CRRL administration will now handle. CRRL will also become sponsor of the RSO Ontario Amateur Radio Service Net (ONTARS).

Canada: Jack Ravenscroft VE3SR passed away 19 October, of a brain tumor.

You will remember Jack as the ham from Ottawa, Canada who was hauled into court by a neighboring family because they claimed VE3SR's operations caused interference to their home entertainment and consumer electronic gear. Jack spent thousands of dollars and four years fighting the case. With the support of the ham community, Jack finally won an appeal that will impact on the lives of every Canadian ham in a most positive way—Communications Canada (formerly DOC) is now considering mandatory RFI immunity standards for consumer electronics.

Ironically, the court-ordered RFI suppression on his neighbor's electronic gear was just being completed as Jack fell ill. Our condolences to Jack's family on their tragic loss.

Germany: The Radio Berlin International (RBI) DX Club provides its members with monthly forecasts for amateur and SWL DXers free of charge on request.

$$ HOME-BREW IV $$

73 Magazine again invites all home-brewers to turn their hot solder into cold cash and prizes, and to get their name in print to boot. All projects have a chance to appear in the magazine, and we will handsomely reward the authors of the *crème de la crème* of these.

Now for the bounty. Ramsey Electronics graciously contributed from their line of frequency counters. First prize is $300, a ten-year subscription to *73*, and a CT-125 1.25 GHz frequency counter. Second prize is $150, a two-year sub, and a CT-90 600 MHz frequency counter. Third prize is $75, a two-year sub, and a CT-70 525 MHz frequency counter. All this is in addition to the payment every author receives for publishing in *73*.

Contest Rules

1. Entries must be received by 1 April 1989.
2. To enter, write an article describing your best home-brew construction project and submit it to *73*. If you've never written for *73*, send an SASE for a copy of our Writer's Guide, or download it from CompuServe (Hamnet forum, Library 0., filename "73WRIT").
3. Here's the real challenge: The total cost of your project must cost under $73, even if all the parts were bought new. Be sure to include a detailed parts list with prices and sources.
4. Our technical staff will evaluate each project on the basis of originality, usefulness, reproducibility, economy of design, and clarity of presentation. The decision of the judges is final.
5. All projects must be original. That is, they must not be published elsewhere. There is no limit to the number of projects you may enter.
6. All purchased articles become the property of *73 Magazine*.
7. Mail your entries to:

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Peterborough, NH 03458-1194
Attn: Home-Brew IV

QRX . . .

The forecasting method conforms to that used by the WARC-High Frequency Broadcasters Committee in Geneva, Switzerland. Membership application request must include three correct reception reports. For further information write to Radio Berlin International, DX Bulletin, 1160 Berlin, GDR.

Great Britain: Necessity is certainly the mother of advancement in amateur radio, all over the world. In England, a recent postal strike hampered the delivery of the Radio Society of Great Britain's (RSGB) GB2RS newscast script to its readers. The RSGB relied on other channels to distribute the document to its anchor people throughout the nation. They FAXed it to some 20 individuals, and made it available to the others via the Prestel database service and packet radio links. The system worked flawlessly, making the GB2RS newscast available to most British hams despite the postal work stoppage. That job action was finally settled on 12 September.

Great Britain: The Radio Amateur Invalid and Blind Club (RAIBC) announces the installation of a new telephone help-line. The number inside England is (01) 346-5372 and the line is open between 1000–1700 UTC each day to take calls from RAIBC members and supporters, as well as those wanting more information about this unique club. On those occasions when there is no one to take a call, an answering machine will record messages.

Israel: A reminder to those hams planning a visit to Israel. You can apply for a reciprocal license directly to the Ministry of Communications office in Tel Aviv, provided that your home nation has a reciprocal operating agreement with Israel. The Israel Amateur Radio Club (IARC) offers help to obtain this license and mail it to you. The IARC will also deliver it to you when you arrive. (See last month's "73 International," p. 103, col. 1.)

Several points to bear in mind: Repeater access in Israel requires a 91.5 Hz CTCSS encoder, and the country's main power is supplied at 230 V AC/50 Hz.

For further assistance, write to Aaron Kirshner 4X1AT, Box 4099, Tel Aviv, 61040, Israel.

Japan: Ham Fair '88—Japan's answer to the Dayton Hamvention—attracted 57,000 visitors to the Tokyo International Trade Center this year.

This is up some 3000 attendees over 1987, making a new record for this event. Highlights included the showing of the latest techniques and equipment for the 1.2, 2.4, and 5.4 GHz band operation. Seminar sessions included a short course in CW while various competitions, including a receiving contest, were also part of the festivities. Visitors to Ham Fair were also able to attend the Japan Amateur Radio Industry Association's "JAIA" Fair which featured the latest commercial gear.

Both exhibitions shared the same facilities this year.

Korea: The annual General Meeting of International Amateur Radio Union (IARU) Region Three took place in Seoul, Korea from 10–14 October 1988.

Approximately sixty representatives from twelve countries out of the twenty-four member societies of Region Three attended. The main topic discussed was preparation for a possible World Administrative Radio Conference as early as 1992. It's expected at that conference that many amateur allocations will come under attack from other spectrum-hungry users. They will also discuss actions on band plans for 160 and 80 meters in Region Three, beacon plans, satellite operations, contests, and emergency operations.

MACC Attack

The Big MACC is again on the attack. The Mid-America Coordination Council (MACC) voted to accept Colorado, the tenth state to join this group. In addition to Colorado, MACC oversees coordination activities in Kansas, Missouri, Illinois, Iowa, Minnesota, Nebraska, Oklahoma, South Dakota, and Wisconsin. These states encompass an area of 721,210 square miles, and contain almost 18% of the amateur radio population of the nation.

KC Coordination Dispute Settled

A long-standing dispute over amateur radio repeater frequency coordination in the Kansas City area has been laid to rest. Representatives of the Missouri Repeater Council, Kansas Amateur Repeater Council, and Mo-Kan Council of Amateur Radio Clubs, have initialed an agreement on how the frequency coordinators for the various parts of Missouri and Kansas should be listed in the ARRL Repeater Directory. The organizations have agreed also to exchange the information contained in their databases. Paul Grauer WØFIR, played a key role in resolving the dispute.

Full details on the settlement will appear soon in "Looking West."

Atlas

Herb Johnson W6QKI is the founder and chief designer of Atlas Radio, Inc. of Oceanside, California. He has asked *73 Magazine* to stress two points about his company, which was liquidated in late 1979.

1) When Atlas Radio was liquidated, it was not sold to any other company.

2) There is currently only one qualified service organization for original genuine Atlas Radio equipment. It is: RF Parts, 1320 Grand Ave., San Marcos, CA 92069; (619) 744-0728.

Big Thanks

Glen Baxter K1MAN, net manager for the International Amateur Radio Network (IARN) of Belgrade Lakes, Maine, gratefully thanks, on behalf of all the members of the IARN, all the manufacturers and individuals who donated equipment to help in the Hurricane Gilbert and future relief efforts. The Heath Company gave an IBM-PC compatible computer to the IARN, complete with a 20 MB hard disk drive; Advanced Electronic Applications donated a pair of PK-232 packet radio terminals; Hal Communications donated an ST-7000 communications terminal system; and Dr. Ernie Adams gave the group a Yaesu FT-757GX transceiver and power supply. Earlier, IARN received the donation of another ST-7000 from Tetsuju Yamada JA1EQZ who is chairman of E-Net and IARN Director for Japan. As the communications demand from Hurricane Gilbert diminishes, Baxter says that the gear will be assembled to serve as a full-time IARN HF Packet BBS on 20 meter, similar to one already in operation on 14.109 MHz by KB1PJ/8 in Cleveland, Ohio.

Glenn reminds all amateurs, especially contesters, that the 14.270–14.280 MHz segment is still very active for handling emergency traffic. While no longer protected by the FCC Mandate issued during Hurricane Gilbert, the IARN still uses 14.275 MHz to handle important medical emergency, relief, and health/welfare traffic.

ITU

A ham will be heading the United States delegation to the next major ITU conference. The State Department announced that C. Travis Marshal W3HPS has been appointed as Chairman of the US Delegation to the 1989 Plenipotentiary Conference of the International Telecommunications Union.

Marshall, who is a Senior Vice President of Motorola Incorporated, will attend the 23 May–29 June conference in Nice, France.

Thanks . . .

To all who contributed news items to this month's QRX column. They are: *Westlink, NABET News*, GB2RS, Radio Berlin, NO9X, AMSAT-NA, Tselil Harmomi, RSGB, ARRL, JARL, and CRRL. Keep your news items and photos rolling in! Address is: *73 Magazine*, WGE Center, 70 Rte. 202N, Peterborough, NH 03458-1194. Attn: QRX

More Microwave Test Equipment for 10 GHz

The Backfire Antenna/Boomerang

by C.L. Houghton WB6IGP

Microwave enthusiasts may recall my article in the October 1988 issue of *73* (pp. 40–41). In it, I describe how to build a 10 GHz detector mount to use with frequency measuring wavemeters and an amplifier. In this article, I will describe the backfire antenna or boomerang, its construction and operation, and the two meter injector. Both devices use a detector mount—either a commercial unit that accepts a 1N23 type diode, or the home-brew mount described in Part 1.

Photo A. Some members of the San Diego Microwave Society having a little fun with ten-foot dishes. Kerry Banke N6IZW with 10 GHz transceiver in hand.

The Backfire Antenna

Industry has used the backfire antenna for many years. Even some of the early amateur microwave pioneers in the 1940s used them. It's a simple concept and easy to apply—I've wondered why it hasn't surfaced earlier in some of our amateur radio publications.

The backfire, or boomerang, antenna is a waveguide-mounted detector to which a source of RF energy is directly inserted into the 1N23 diode, producing a flow of current. The RF comes from a single-stage 2N2222 transistor oscillator, crystal-controlled at 30 MHz (our IF frequency) for stability. This is all you need, besides a small horn antenna to receive and to act as the transmit antenna for the boomerang. You can build the oscillator or use an International Crystal oscillator board powered by a 9 volt transistor radio battery. See Figure 1 and system photographs.

Photo B. Commercial mount with 1N23 type diode now fitted with varactor for connection to a 2-meter HT. Home-brew mount works just as well.

The 30 MHz signal injected into the detector diode mount by itself is not productive, but when it is injected with microwave energy via the horn antenna, it produces upper and lower mixer products detectable by your full-duplex transceiver. Modulation isn't usually detectable unless it is imposed on the 30 MHz oscillator. You will detect a return CW carrier when your antenna is pointed in the direction of the boomerang. You will detect modulation from the source when even when the boomerang is fairly distant from the Gunn oscillator. Signals at this point are very weak and are a result of the time/path differences.

With the microwave injection mixed with the 30 MHz oscillator, it doesn't matter which microwave frequency you use to obtain a return from the boomerang. I tried this same operation at other microwave frequencies, and operation is just as good as it is on 10 GHz. Design is not critical. Just use a resonant waveguide for the frequency and inject your IF frequency into the detector mount.

Ed Munn K6OYJ has even used a tin can fitted with a diode as part of a polaplexer for boomerang operation on our 3 GHz band. See Figure 2. When I finish my 5 GHz Gunn oscillator, I intend to build another boomerang out of some scrap 5 GHz waveguide, or possibly a used Sardine can, just for fun. If you don't play, how can you have any fun with these microwave bands?

IF System Required

The IF system must operate around 30 MHz. If your system uses a different intermediate frequency, change the crystal to match. Operation is the same. There will be some problems if your IF is high, say 100 MHz, because of the input matching and loading of the 1N23 crystal.

If you slowly separate the receiver and the boomerang, you will see a very defined peak, and as you move them further apart still, you will see a null. The phase difference between the 30 MHz signals, which can be used to measure distance, causes this change. You can also change the frequency of your microwave transmitter in small kHz steps and observe the null and peak at each frequency. You can measure distance from this.

Bore Sight

The boomerang or backfire antenna shines when used as a target for your antenna. With the unit perched at some distance, you can sight down the axis of your antenna and draw a straight line between the two. You can use it for antenna measurements to peak your system. Be sure your transceiver is on the frequency you wish to peak up, as it does not matter to the boomerang. As you increase the

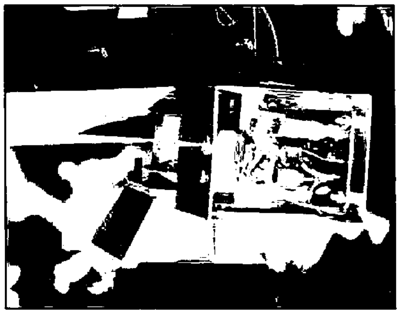


Photo C. Boomerang bottom view showing 30 MHz oscillator (International Crystal) mounted in small LMB box.

distance, you obtain a weaker signal and a much more defined antenna pattern. If the boomerang is moved about the front of your antenna, you will be able to detect the main lobe and the focus of the electrical axis. Moving around the sides, we would expect to see some side lobes, but the null and peak previously mentioned makes these measurements very difficult.

Just for fun, one day members of the San Diego Microwave Group gathered around several large dish antennas located in the backyard of Kerry, one of the members. We speculated on the pattern we would obtain if we tried a new frequency, DC or sound, instead of electronics. We moved our heads into prime focus and whispered to other members about a hundred feet away. Not bad. The gain of the ten-foot dish at audio frequency was very good, in fact. Stepping into the main lobe quite a distance away from the dish, you were soon pelted by very loud, focused sound—*full duplex!* You could whisper so low that a person standing three feet away could not hear you, yet the person at the feedpoint of the dish was copying solid and very loud. Now if we took the boomerang with a 1 kHz audio oscillator and. . .?

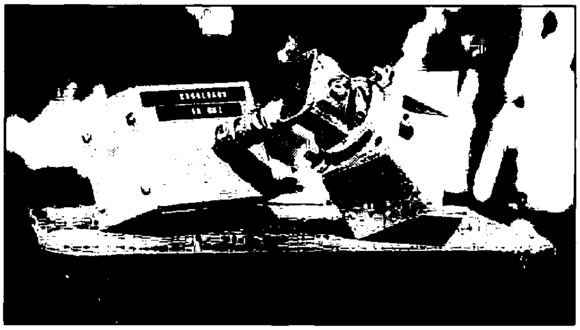


Photo D. Rear view of Boomerang showing back construction used on home-brew detector mount.

When you know the distance your system will work at with a very narrow antenna beamwidth, try setting your microwave dish in a new spot, and then aim it at the boomerang with the 30 MHz oscillator turned off. When you think you are on target, turn on the boomerang and recheck for maximum signal and antenna orientation. This way you will become more familiar with the aiming characteristics of your antenna. I thought I was pretty good until I tried it, but I had to do some re-evaluating. It is like learning how to hold a camera steady when triggering the shutter. By dry-running the antenna, you improve your accuracy in pointing your system and make more contacts. One to two degrees beamwidth is not much to play with.

Use a map to point your dish antenna on distant points. Don't get one from your local service station; instead, obtain a quality survey map. US Geological Survey quadrangles describe in detail the topographic areas of interest from small to large. You'll also need a good compass. For aiming your antenna, Sears has several levels that will give you an indication of mount positioning and inclination. I found a General bubble bull's-eye level, the size of a quarter, at our local hardware store for $2.39. It has 45 degree markings and is quite sensitive. It proved useful in adjusting antenna orientation.

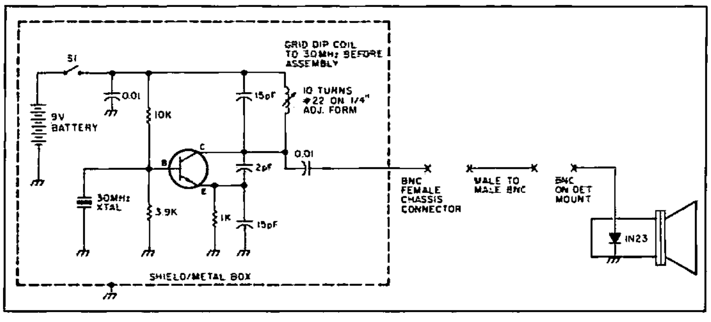


Figure 1. Schematic of oscillator that produces the RF that drives the 1N23 diode in the wave-guide mounted detector.

The other advantage of the boomerang is that it will tell you quickly when your transmitting Gunn oscillator is putting out microwave energy. It does not care what frequency you are on. It will return a CW signal, which tells you that your receiver is operating and gives a quick reference for system evaluation.

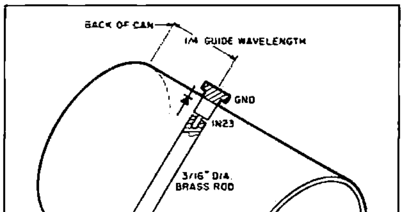


Figure 2. A tin can fitted with a diode as part of a polaplexer for boomerang operation on the amateur 3 GHz band.

Two-Meter Injector

The 2-meter injector is a detector mount that uses a varactor or step-recovery diode as the driven element. We have used an input pad to limit the RF drive from our two-meter HT which, on low power, puts out 200 mW. Pad values were 10 dB to limit the drive to about 10 mW, and 3 dB for 100 mW of drive to the SRD diode. See Figure 3. The diode is rated at 1 watt dissipation. The pad also serves as a DC return for the SRD diode in the detector mount. The best mount possible for the SRD diode would be a commercial unit, as I am not crazy about threading the tip of a somewhat expensive diode. You might want to construct the second version (with the brass tubing on top) with the BNC connector. Either mount will work well, and each has advantages over the over. One offers ease of construction, while the other requires more soldering expertise. Details on both mounts were described in Part 1 of this article. See Photo B, a surplus mount with 3 dB pad, and Photo C, my second version with a BNC connector.

Ed Munn K6OYJ, a member of our San Diego Microwave Group, provided the diode I used. It worked quite well. We knew it was a varactor with a reverse breakdown of 42 volts at 10 micro amps and a junction capacity of 2.31 pF at 6 volts (1 MHz test frequency) and the same case style as a 1N23. The closest commercial diode that I find listed is the Microwave Associates MA-44641D Step Recovery Varactor. I'm currently trying to find one of these devices to test in the mount. Check your local surplus dealers and put that old scrounging effort to work. See Photo B, varactor mount.

I will make available high power Gunn diodes, case style 118 with silver plated brass rivets, for modifying Solfan type cavities operating on 10 GHz. These devices have power outputs from 50 to approximately 100 mW (+15 to +20 dB) for $5 each, postpaid continental US. Some select higher power devices for 6 GHz, 10 GHz, and 18 GHz. Output power varies from cavity to cavity and post mounting arrangements, but all devices are tested prior to shipping for RF. I would be happy to answer any questions regarding this or any other microwave related project. Please contact me at 6345 Badger Lake, San Diego, CA 92119.

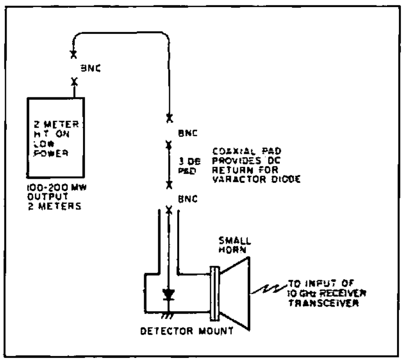


Figure 3. Diagram for the 2-meter injector system. It loads a step-recovery diode (in the detector mount), which generates many harmonics. The 70th harmonic of 146 MHz is 10.220 GHz.

SUPER SIMPLE ATTENUATOR

A construction project for many uses

by W.C. Cloninger, Jr. K3OF

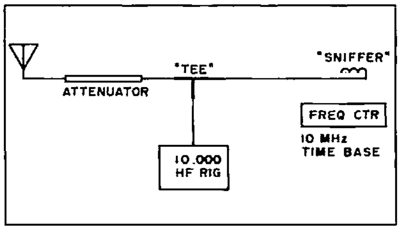


Figure 1. The attenuator balancing two 10 MHz signals into an HF receiver.

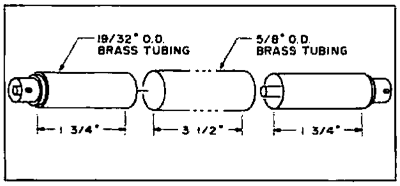


Figure 2. Tube dimensions for the attenuator.

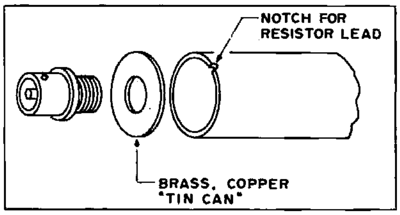


Figure 3. BNC connector attachment details.

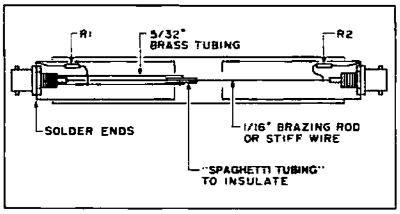


Figure 4. The final assembly of the attenuator.

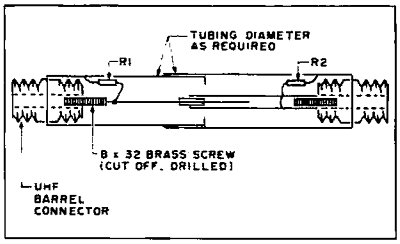


Figure 5. Two-tube attenuator system.

Here is a simple, adjustable, and easy to build attentnator, which has a variety of uses. It uses a simple capacitive coupling with an attempt at a reasonable impedance match. It is a simple one evening project using easy to obtain materials.

Some Practical Uses

Before getting involved in the construction of the attenuator, look at several of its uses. The constructor can think of additional uses to fit his own needs.

I first constructed the attenuator for "rabbit hunting" (DFing 2 meter hidden transmitters). It is a little difficult to get a beam heading when the S-meter on the rig is at full scale all the time. The attenuator provides the answer for adjusting the received signal for a less than full scale reading. With the attenuator I could determine the peak or null depending on the type of antenna I was using. The attenuator is an absolute must for reducing any strong or weak signals when close to a transmitter.

In addition to the original use, I found that it has been just the item I needed to use with test equipment. Figure 1 shows how I used it to "balance" two 10 MHz signals into my HF receiver to zero beat my frequency counter. (Hint: If considering to purchase a frequency counter, give strong consideration to the one with a 10 MHz time base that can easily zero beat with WWV on 10 MHz. It is easily worth a few dollars more to be able to check and adjust the counter time base by hand.)

Other routine uses are to limit input to my frequency counter and my FM deviation meter. I use a "gimmick" in my dummy load to pick up RF and causing the level to be significant at high power levels. I quite often feed this RF directly into the test equipment. It ensures that the signals do not overload the input of the equipment, and more importantly do not damage the equipment. This attenuator is for use with low level RF and receive type signals. It is not to be used with a transmitter since R1 and R2 are ½-watt resistors.

Construction

Construction is very simple, and the only items I did not have in my junk box were the pieces of brass tubing. The local hobby shop had an assortment of brass tubing from about 1/16" to 1". It comes in so many different sizes that each larger size will just slide over the next smaller size. Just pick the size that suits the need of the type of connector being used. Dimensions are given in Figure 2 for the attenuator I built when using BNC connectors. There is nothing critical about dimensions. I used a three tube system, but the constructor can just as easily use the two tube system seen in Figure 5.

I made the end plates from a piece of tin can stock shown in Figure 3. I drilled the appropriate hole for the BNC connector, installed the connector and tightened the nut. It is important to tighten the nut before assembly, since access to the nut is impossible after soldering the end plate to the tubing. Now solder the solid wire and the small diameter brass tubing to the appropriate connectors. Use care to keep the tubing or wire in good alignment with the axis of the center conductor. Add a 47Ω ½-watt resistor to each center conductor as shown, but leave the other end of the resistor free for soldering during final assembly.

"The attenuator is an absolute must for reducing any strong or weak signals when close to a transmitter."

I used 1/16" brazing rod for the center wire. I find brazing rod very useful for a lot of projects around the shack. I inserted a small piece of spaghetti insulation into the 5/32" tubing. It might be just as easy to place heat-shrink tubing over the 1/16" rod.

Now assemble everything as shown in Figure 4. Place the large brass tubing sections in their closed position, and the two connector end sections into their final position. This assembly, before soldering the end plates, puts everything into alignment. Solder the end plates and the ends of the 47Ω resistors to the large tubing. File or grind any excess metal from the end plates. This completes construction.

This is a handy addition to any workbench or shack. Enjoy!

THE 220 MHz ALL-MODE TRANSVERTER

Designed for the dedicated home-brewer.

by Robert E. Bloom W6YUY

Because of the increased interest and activity in 220 MHz single sideband and the positive response to my Two-Meter Transverter project in July 1987 *73* (pps 32–43), I have now designed an improved, 220 MHz version of the transverter. This transverter is capable of FM repeater operation as well as CW and SSB, and it's much more sophisticated than the usual FM transceivers and hand-helds on the market. All frequencies on this unit can be set with direct read-out to the nearest 10 Hz. Of course, DX simplex operation on both FM and SSB is one of its most exciting features.

Like the earlier unit, this is an all-mode transverter specifically designed to interface with the Kenwood TS-940S HF transceiver. It will also work with other full-frequency coverage transceivers equipped with a transverter access plug. The transverter has a CW output of 3-½ watts. I will cover in a later article a 220 MHz DMOS linear amplifier with a power output of 60 watts.

Why Not PC Cards?

The construction of this unit uses point-to-point wiring in a soldered PC-card structure that provides several benefits.

1. A printed circuit board would require foil circuits on both sides, making double-deck construction impossible.
2. Compartmentalizing would require a separate PC board for each stage or section.
3. A PC card would require more space because of restrictions on parts placement. With this type of construction you can use the walls of the compartment as well as the floor for mounting parts.
4. Exact duplication of components is not required.
5. Excellent interstage isolation.
6. More freedom and ease of modification than normal printed circuit board techniques.

Your TS-940 transceiver must be modified, of course, to work with the 220 MHz transverter, because 222 to 225 MHz will be mapped into 22 to 25 MHz and the unmodified transceiver will not transmit outside the ham bands. (Obviously, it is not legal to transmit with the modified Kenwood outside the amateur bands authorized by your class of license.)

Take It Step-by-Step

Realizing the apprehension you may feel when looking at a complex project, I provided, in Figures 5 and 6, drawings of the layout of the major parts. By showing the approximate placement of coils, tuning capacitors, and transistors, I hope to simplify the placement of the rest of the components for you. Since you are building this unit step-by-step, you won't have to place the shields between stages in exactly the locations shown in the drawings. Also, your components may be of different sizes, but the compartments should have enough space in most cases.

THE HOUSING

Case and Module Fabrication

The 220 MHz transverter is a one-piece module with a housing made up of double-sided PC board material. The top of the chassis contains the receiver and oscillator chain; the bottom has the transmitter and control circuitry.

The outside dimensions of the transverter assembly are 8-⅝ x 4-¼ x 2-⅜". The height of the partitions is 1/16" less than the depth of the compartment, so the top and bottom covers fit flush with the side panels. Similarly, the front and back panels are ⅛" wider than

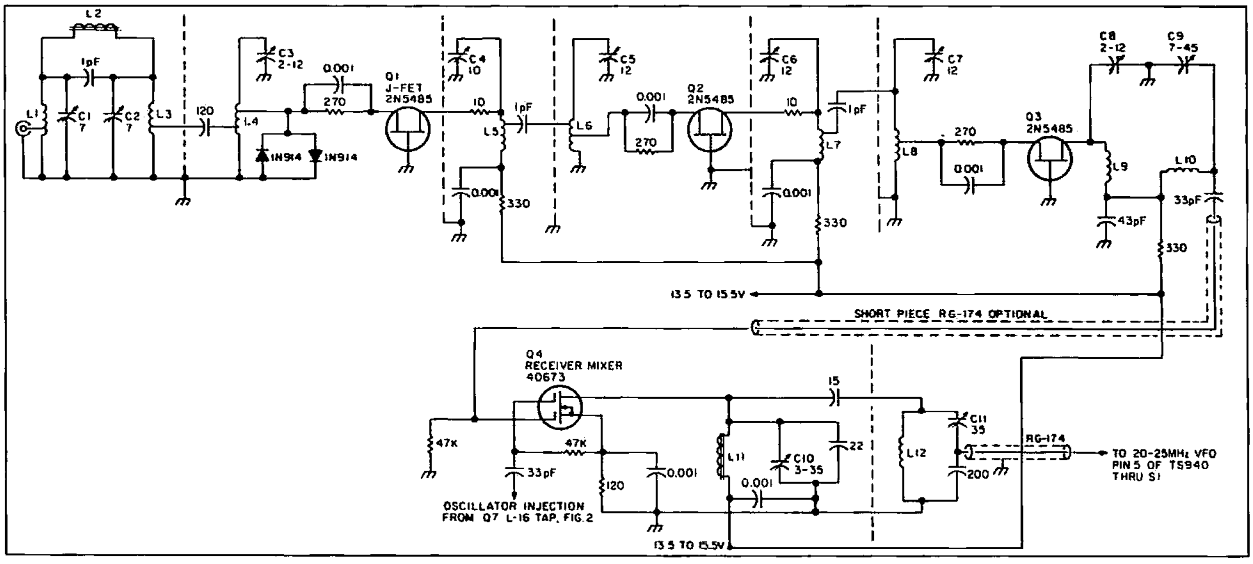


Figure 1. Schematic of the receiver portion of the 222–225 MHz transverter.

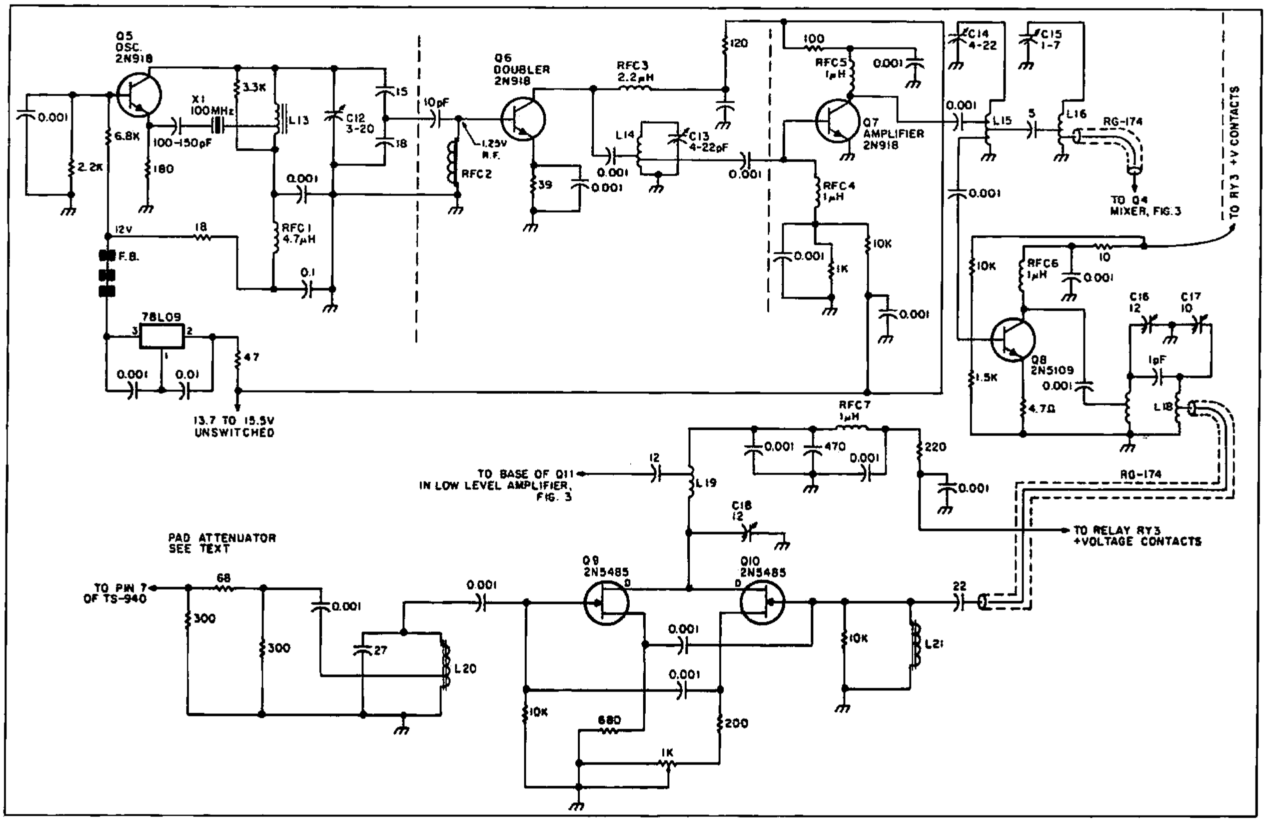


Figure 2. Schematic of crystal oscillator circuit (100 MHz) and doubler.

the main circuit board chassis to allow for the 1/16" side panel thickness.

Draw a pencil line down the middle of each side piece to help in locating the main center board that separates the top from the bottom. Start by tack-soldering just inside each end, making sure that the sides are at exact right angles with the center board. Then tack the end pieces into position. When the box is square, solder the corners and then seam-solder the sides from the inside.

Figures 5 and 6 are parts layout drawings showing the individual compartment sizes, ±1/16" and do not allow for the ±1/16" thickness of the separators. These dimensions are flexible and can be used as an indication of how much room you need and how much space you have left as you go along.

The compartment separators are also made up of double-sided PC card stock and construction is serial: you complete one stage and install a separator before going on to the next stage. This way, you won't be caught either short or long on space. Drill all feedthrough holes in the compartment separators before soldering the separators in—drilling afterwards is difficult!

Single-sided PC stock is used for the terminal mounting pads to which component leads are soldered. If all the PC material you have is double-sided, you can remove the foil from one side by holding the material in a bench vise, heating one side gently with a propane torch, and pulling off the foil with pliers.

Make up a supply of single-sided strips—⅛", 5/32", and ⅜" wide—and snip off pieces as needed with diagonal cutters. Using a single drop of Eastman 910 cement (Crazy Glue), position these pads where needed with long-nose pliers. Four seconds later, you can solder to the pad. Should you decide that the pad is not in exactly the right position, you can remove it by prying with a pocket knife or small sharp screwdriver. Do not re-use a pad, as it will not hold securely the second time.

The unit will operate well without the covers in place. However, when the top cover is removed exposing the receiver's pre-selector stages, the unit will pick up strong signals even if it isn't connected to an antenna. Rather than secure the covers permanently, you can hold them in place with transparent tape for easy access to the circuitry.

Panel Hardware

You can drill the holes in the front and back of the case either before or after the box is

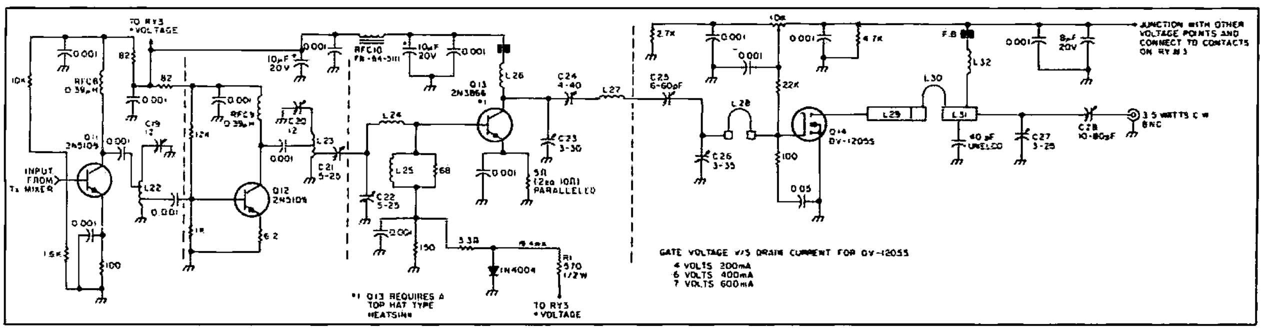


Figure 3. 220 MHz transmitter low-level amplifier section.

220 MHz Receiver
Major Components Parts List and Coil Data
(Small resistors, capacitors, and inductors not listed)

C-1, C-2	1–7-pF quality miniature piston capacitors
C-3–C-8	2–12 pF Johnson air variable, PC board ceramic
C-9–C-12	3–35 pF ceramic variables
L-1, L-3	Four turns #16 or 18 tinned wire ¼" inside dia., tapped at 1-¼ turns
L-2	19 turns #20 enameled wire on T-50-12 Amidon core, or 21 turns #24 enameled wire on T-37-12 core
L-4–L-9	4 turns #16 tinned wire, wound on #3 drill (0.212"), all four turns spaced 1-½ wire diameters
L-4	tapped at ¾ and 2-½ turns
L-5	tapped at 2 turns
L-6	tapped at ½ and 3 turns
L-7	tapped at 2-½ turns
L-8	tapped at 3 turns
L-9	no taps
L-10	tapped at 3 turns
L-11	22 turns #28 enamel wire on T-25-6 Amidon powdered-iron toroid core
L-12	Same as L-11 but 19 turns
FB Ferrite Beads	101 size of 43, 64, or 75 material; typical Amidon designation, FB-43-101
Q-1–Q-3	2N5485 or 2N5486 (or equivalent) JFETs
Q-4	40673 or 40673A dual gate MOSFET
Q-5–Q-7	2N918 transistor
Q-8	2N5109
Q-9, Q-10	2N5485 or 2N5486 JFETs

Note: All resistors used in the project are ¼ watt ±10% unless stated otherwise.

Table 1.

assembled. The front panel has two BNC bulkhead connectors on the left edge. One is for received signal in and the other is for transmitted signal out, to interface with the power amplifier. An LED shows when power is applied. The three-pole, double-throw miniature switch and eight-pin male mike bulkhead connector complete the panel. The eight-pin connector couples to the TS-940 interfacing cable. The back panel has a four-section miniature barrier strip for source power to the transverter.

CIRCUIT SECTIONS

Receiver Converter

The receiver portion (shown in Figure 1) has three JFET pre-amplifier stages. Dual gate MOSFETs would provide twice the gain, but much less stability and more noise. The bandwidth of these stages is set by positioning the taps on the RF coils (see the Coil Tapping sidebar). A tap placed closest to the top or high impedance point of the coil provides heavy loading, driving the Q of the stage down for a broader bandwidth. The lower the tap point, the higher the circuit Q, and the more selectivity and gain per stage.

Because the transverter is not retuned during operation, the bandwidth or bandpass discussed here is the total bandwidth over which the transverter will work. The actual operational selectivity is provided by the TS-940 being used as a tunable IF.

Each of these stages provides about 12 dB of gain, with 15 dB the maximum. A bandpass and image frequency rejection filter precedes the preamplifier.

Crystal Oscillator

The oscillator is a variation of the Butler design—one of my favorites. The oscillator circuit is particularly suited for overtone crystals, and, with light loading, is very stable.

The oscillator coil L-13 in Figure 2 is tuned by a network of fixed and variable capacitors. The variable capacitor is tuned for resonance, while the parallel and series divider provides the required drive level to the frequency doubler. (With the proper selection of capacitors, we can retain the correct parallel [product-over-the-sum] capacity, and we can select a correct drive level for the frequency doubler. In addition, we reduce loading on the oscillator output circuit.)

The selection of coil tap on L-13 provides the oscillator feedback voltage required for stable oscillation. The 100 MHz crystal oscillator feeds the doubler, which retains about 66% of the oscillator's energy. Using a 100-MHz crystal and a doubler, the 200 MHz is much cleaner than it would be if you used a tripler. A simple doubler circuit provides the required 200-MHz output frequency, while the amplifiers with double-tuned bandpass circuits clean up the frequency from the output of the doubler stage.

To further clean up the 200 MHz signal before it enters the receiver mixer, we add a third amplifier and bandpass filter stage. A fourth, and similar amplifier stage provides the heavier signal required for the transmitter mixer. The double-tuned bandpass filters in these amplifier stages clean up whatever garbage is generated in the early stages of the oscillator chain.

Transmitter Mixer

Much research went into the determination of transmitter mixer circuitry. Both active and passive, double- and single-balanced types were studied. I selected the single-balanced, active JFET circuit after comparing major characteristics such as dynamic range, suppression of intermodulation products, and cross-modulation effects. FETs were selected over bipolar transistors for their inherent transfer characteristics approaching a square law response, thus providing a reduction of third overtone products. Harmonic distortion and cross-modulation effects are third-order dependent, and are greatly reduced when using FETs in a balanced mixer.

For RF amplification, use the following guide to set up the DV-1205S V-MOSFET stage Q-14 in the main transverter unit (see Figure 3). The level of drain current and ultimate power output of the stage is a function of gate voltage controlled by the 10k potentiometer. Four volts gives a drain current of 200 mA, six volts yields 400 mA, and seven volts sets up 600 mA. If you don't get an increase in power output with increased drain current, you don't have enough drive power and it isn't economical to increase the drain current further. Since this project has three MOSFET linear amplifier stages, set the output levels for only what you require. On the other hand, if the drive is much greater than you need, don't worry about blowing the FETs, since you cannot hurt them by overdriving.

Control Circuit Function

Refer to Figure 4 and Table 4. Plugging the DIN plug into the TS-940 mechanically switches the TS-940's input circuitry to desensitize it to HF signals. At the same time,

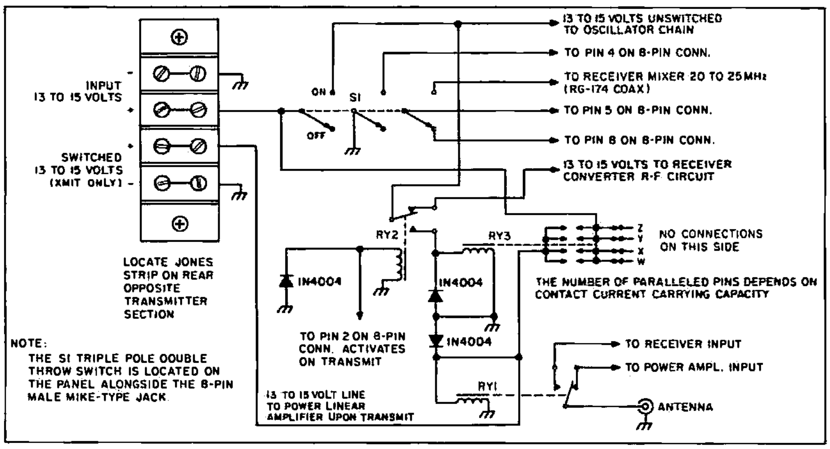


Figure 4. Control circuit wiring diagram.

With SW-1 ON, the first set of switch contacts applies 13 to 15 volts from the input terminals of the barrier strip to the RY-2 armature contact, providing voltage to all of the receiver circuitry and the oscillator chain (except for the Q-9 stage). The second set of switch contacts grounds the coil of RY-3 in the TS-940S, closing the relay, disconnecting the VFO, and disabling other LF circuits in the TS-940.

When you press the microphone push-to-talk (PTT) switch, the Kenwood puts 12 volts at 50 mA on pin 2 of the 940's DIN plug, activating the transverter RY-2, which in turn removes the supply voltage from the receiver and activates transverter RY-3. RY-3 then applies supply voltage to the Q-9 output stage along with all the source voltages to the transmitter section. In addition, plus voltage is supplied to the barrier strip for the outboard linear amplifier and antenna relay #1. Releasing the PTT switches the transmitter and its associated circuitry off, and returns the unit to receive.

Toggling SW-1 to OFF, the arm of the third pole connects pin 5 with pin 8 on the 940's transverter plug. This allows the TS-940 to operate in the normal manner on HF, even though the transverter is still connected.

When purchasing the RY-2 control relay, keep in mind that its 12-volt actuating voltage comes from the TS-940, and the maximum current available is 50 mA. Many 12-volt relays require more than twice this level. The unit you select should have a field coil resistance of *no less than* 250 ohms.

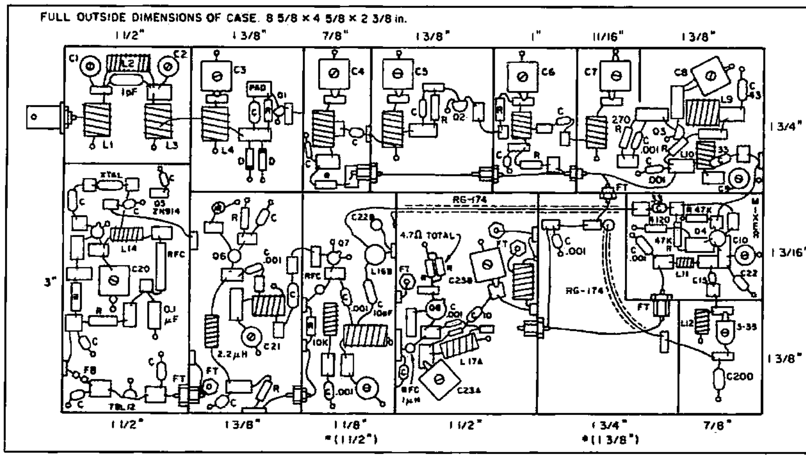


Figure 5. Major parts positioning (approximate dimensions) for the receiver and oscillator, top section.

TS-940

TS-940 Interface Cable

A 30" cable connects the transverter to the XVTR plug on the back of the TS-940 (see Table 4). Get the eight-pin DIN plug from Kenwood. Don't try to buy this plug elsewhere, as the plug you get probably won't fit the Kenwood's jack. I purchased three from other sources; no two were the same and none of them fit the TS-940. Just connect like numbers on the DIN plug and the eight-pin mike jack. You'll need three runs of small-diameter coax for pins 5, 7, and 8. Use cable with a Teflon dielectric. Don't use RG-174—the dielectric can melt during soldering, causing a short. Pins 1 and 3 are shield ground. Use a good grade of #20-stranded between the two number 2 pins and the two number 4 pins. Pin 6, ALC on the transceiver, is not used. Pin 6, by the way, is the center pin on the DIN plug, while pin 8 is the center pin on the eight-pin mike connector...

Recall that the very act of inserting the DIN plug into the 940 transverter jack disconnects the HF front end in the 940 to avoid leak-through of HF signals at what is now the first intermediate frequency. In order to use the Kenwood on HF when the transverter is plugged in, a switch in the transverter connects pins 5 and 8 when the transverter is turned off.

Pin 2 provides 12 volts (at a maximum of 50 mA) during transmit for use as PTT in the transverter. A ground on pin 4 by the transverter disables the TS-940's power amplifier. RF/IF input signals between 22 and 25 MHz come from the transverter to the Kenwood on pin 5 with the outgoing (transmitted) signal at a level of about 100 mW on pin 7. Pin 8 is the TS-940's HF input, which must be connected to restore HF operation.

TS-940 Modification

To enable the TS-940 to transmit outside the regular ham bands, cut diode D-130 from the circuit. The transceiver will then transmit anywhere between 1500 kHz and 30 MHz. D-130 is located on the unit "B" PC board just behind the LCD display on the panel. (The diode is identified, as are other components, by screening on the PC board.) I removed the five screws on the module containing the board, but the board is still difficult to access and requires patience. A letter from a New Zealand reader of my previous transverter article suggested loosening the panel to the point where it could be tilted forward, exposing the diode, which is then cut free at one end using a diagonal cutter. The VFO frequency for the tunable IF is 22 to 25 MHz. Thus, the TS-940 dial read-out for a frequency of 223.259.81 MHz will be 23.259.81. The first digit "2" is understood, as all of the frequencies are in the 200-MHz range. For example, 22 on the dial indicates 222 MHz, plus all of the subsequent digits. Note that the frequency is read to the closest 10 Hz, so be sure to zero-beat both the TS-940 crystal and the transverter oscillator to WWV.

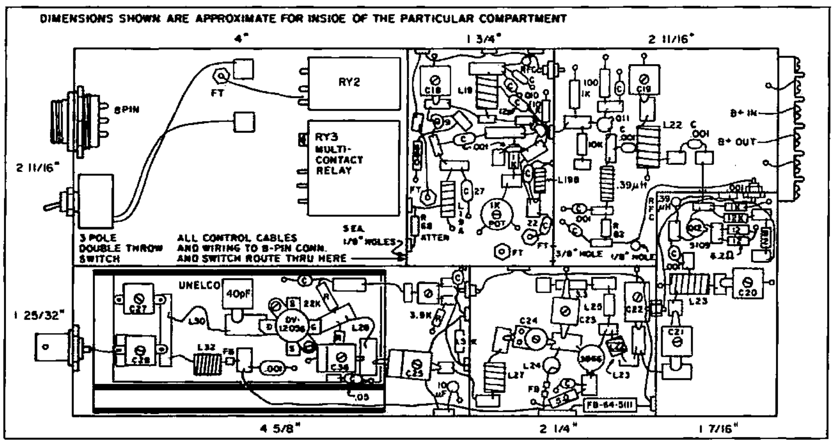


Figure 6. Major parts positioning for the transmitter and control, bottom side.

Construction Aids

Figure 4 shows the control circuit wiring diagram. Schematics for the receiver and transmitter sections, as well as separate major parts list for each section, are furnished. See Tables 1–3. In addition, see the photographs of both top and bottom views of the transverter.

If you follow the coil winding data, you should not have a problem attaining resonance in any of the stages. Coil construction has been further simplified by using toroidal cores. These are readily available in small quantities at under a dollar each from *Amidon Associates, Inc., 12033 Otsego St., North Hollywood CA 91607.* Tell them you saw the cores mentioned in *73 Magazine.*

Potpourri of Technical Construction Notes

In the bandpass filter in the Q-4 transistor stages, L-10 is lightly coupled and at right

220 MHz Oscillator Chain and Transmitter Mixer Major Components Parts List

C-12	3–20 pF miniature air variable or ceramic disk
C-13, C-14	4–22 pF miniature air variable or ceramic C-151–7 pF piston capacitor
C-16, C-18	2–12 pF Johnson air variable used on PC boards
C-17	2–10 pF Johnson similar to C-16
RFC-1	4.7 μH
RFC-2	3 turns on FB-64-5111 6-hole Amidon ferrite core
RFC-3	2.2 μH
RFC-4–7	1.0 μH approx. 25 turns of #28 enameled wire on a ½-watt resistor form
L-13	7 turns #20 enameled wire tapped at 2 turns from cold end, wound on a T-37-12 powdered-iron Amidon toroid core
L-14	4 turns #18 bus wire 3/16" inside dia., 9/16" long, tapped at ¾ turn at 3-¾" from cold end
L-15	5 turns #18 bus wire 3/16" ID x ½" tapped at 1-½, 2½ at 4 turns
L-16	6 turns #20 tapped at ¾ at 5 turns
L-17	5 turns #18 bus wire ¼" x ½" tapped at 1-½ turns
L-18	4 turns #18 bus wire ¼" x ½" tapped at 1-½ turns
L-19	4 turns #16 bus wire wound on #3 drill (0.212") tapped at 1-½ turns from cold end

Table 2.

angles to the center of L-9. Do not place L-9 and L-10 closer than ¼" to each other. The bandpass filters of both the Q-7 and Q-8 circuits also have their coils at right angles for minimum coupling. Here, the coupled coils should be placed at least 1" apart, so that coupling is primarily through the 5 pF and 1 pF capacitors, respectively. Even at this distance, there's some mutual coupling.

There are a number of places where RF chokes are called out. Most of these are wound using ¼- and ½-watt resistors as the coil forms. The following should assist in coil winding.

A reactance vs. frequency, capacity, and inductance chart or a cardboard reactance slide rule are great tools. A grid dip meter is another. You'll need several 0.39-μH chokes. A 0.39-μH choke will resonate at 50 MHz when shunted with a 27-pF capacitor. By using this point, you can locate other capacitance and inductance values on the scales. You can make the 0.39-μH unit with a ½-watt resistor of 3000 ohms or more. Make notches at the ends of the resistor with a jeweler's file to prevent the wire from slipping. Close-wind 25 turns of #28-gage enameled wire on the resistor, and grid-dip with a capacitor to check the value.

You'll also need some 1.0-μH chokes. These should resonate at 16 MHz when shunted with 100 pF. Fill a ½-watt resistor with #31 wire. Wire size is important. Note that 25 turns of #28 wire on a ½-watt form also makes the same 1-μH value. As an additional aid, note that a value of 0.18 μH resonates at 70 MHz when shunted with 27 pF.

Refer to the dimensions of stage components. Notice that on the receiver side, a compartment of 1¾" has only a few components. This compartment originally had a redundant stage. Notice also that the Q-7 stage is a bit crowded. If you expand the width of this compartment, you will be able to move the Q-8 stage down.

On the front panel, the BNC connectors are located 1" in from the case edge and are 1-¼" on center from one another. The eight-pin mike-type connector is ⅞" in from the opposite edge of the case. Positioning of these parts is not critical.

I had no problem laying out the complicated transmitter section. If you need more width, the Q-12 adjacent stage has plenty of room and can be moved further to the right.

A number of relatively long conductor and RG-174 (⅛" coaxial cable) runs enter and leave compartments that are not adjacent, but opposing. Also, some of the feedthrough terminals are *not* bypass capacitor feedthroughs. These also come out on the opposite side of the box (top or bottom). Carefully check to make sure that there is nothing in the way on the opposite side, and that the feedthrough enters the proper stage on that side. The component layout drawings represent relative positioning. In order to keep the drawing clear, only major components have been drawn in.

Caution: The Q-13 2N3866 transistor requires a top-hat heat sink. The case of this transistor is connected to the collector and it takes unkindly to being shorted, even for an instant. *Make sure the top hat clears other parts when positioning this transistor on the board.*

220 MHz Unit RF Chain Major Parts List for Transmitter

C-19, C-20	2–12 pF Johnson air variable for PC boards
C-21–C-23	5–25 pF Arco 400 series compression
C-26, C-27	5–35 pF Arco 400 series compression
C-24	4–40 pF Arco 400 series compression
C-25	6–60 pF Arco 400 series compression
C-28	10–80 pF Arco 400 series compression
Q-11, Q-12	2N5109 transistor
Q-13	2N3866 transistor with top-hat heat sink
Q-14	M/A COM PHI RF power MOSFET DV-1205S 5 watt
L-22	5 turns #18 bus wire, wound on #3 drill, 9/16" long, tapped at ½ and 1-½ from cold end
L-23	Same as L-22, tapped at ½ and 1-⅝ turns
L-24	3 turns #18, 0.3" diameter spaced 2 wire diameters
L-25	7 turns #28 wound on a 62 or 68 ohm ¼ watt resistor
L-26	5 turns #18 bus wire on #3 drill, 9/16" long
L-27	3 turns #18 bus wire on #3 drill, spaced 3 wire diameters L-28, L-30 ¾" of #16 tinned bus wire bent into a hairpin ⅓" diameter
L-32	8 turns #22 Teflon covered wire, close wound ¼" diameter
L-29	¼" wide strip of single-sided PC board material, epoxied as though it were another pad 0.66" long
L-31	As in L-29, but ½" long
R-1	Part of Q-18, 2N3866 bias circuit 570 ohm, made of a 1k ohm and 1.3k ohm ¼-watt resistors paralleled

Table 3.

Test Equipment

In order to test and align your transverter, you will need the following test equipment.

1. A stable signal generator or calibrated oscillator and adjustable 50 ohm attenuator covering the appropriate RF range.
2. An electronic frequency counter covering the appropriate frequency range.
3. A VHF range RF vacuum tube voltmeter or a good DC VTVM with UHF RF probe. (Solid state is fine, too.)
4. A VHF grid dip meter to check coil resonance. (Not absolutely necessary if you follow coil winding data closely, but a real aid.)
5. A capacity bridge to confirm small values of capacity marked, and to set a given capacity in a test circuit. (See *Ham Radio*, March 1980, page 54.)
6. A Bird Model 43 wattmeter or other power measuring device, and a 50 ohm load (termination).
7. A multi-range Volt-Ohm milliammeter.

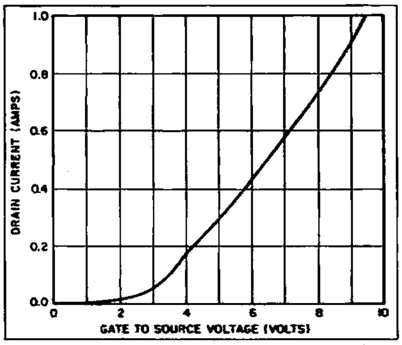


Figure 7. Drain current vs. gate-to-source voltage for the DV-1205S, located in the low-level amp section.

Where To Find Components at Reasonable Prices

In this project you will use quantities of miniature plate capacitors, various sizes of compression capacitors, disc ceramic variables and fixed capacitors, and dipped silver micas (dog bone) components. Fixed disc ceramic of 0.001 mF are sprayed around the source voltage lines as bypasses and as both coupling and decoupling circuits. In circuits requiring a degree of stability, use silver mica. Miniature PC board air variables, Johnson 2–12 pF, usually 8 plates total, are used in stable RF circuits. These plates and small, high quality Arco compression type resonate coils.

You will notice lots of tuning capacitors. This adds up to a nice piece of change. Many of the stages in the receiver could be tuned temporarily with a good-quality variable capacitor. Remove the variable carefully so as not to change its setting and measure its value with a capacitance bridge. Now insert a dipped silver-mica of that value in that spot. You can make minor adjustments by compressing or expanding the coils on the toroidal core until resonance is re-established. This is a mildly complex substitution I have seen described in many publications.

All powdered iron and ferrite toroidal cores and baluns are available from Amidon Associates. You can buy the eight-pin DIN plug from Kenwood. Get two. The price ranges from $2 to $2.50 each. I purchased my crystal from *Jan Crystals, 2400 Crystal Drive, Fort Myers, Florida 33906-9989.* Order series resonant 0.001 percent accuracy and enclose a schematic diagram of the oscillator circuit.

MHz Electronics Inc., 3802 N. 27th Ave., Phoenix, AZ 85017 advertises in most ham publications. They also have crystals, transistors, and Unelco noninductive capacitors for the power amplifier. (Send for a catalog.)

Another excellent source for dipped silver mica capacitors, miniature variables, JFETs (15¢), 4067 (25¢) relays, and the small heat sink 2N3866 is *Hosfelt Electronics, Inc., 2610 Sunset Blvd., Steubenville, OH 43952.* The eight-pin mike type plug and jack are available from *Henry Radio* and *Radio Shack.*

Parts are also available at ham swap meets, and I have some items at very reasonable prices. If you have questions or comments, feel free to write me. Enclose an SASE for a response. Upon completing this project (I wish to emphasize taking your time, step by step), the gratification and pride you will feel cannot be expressed on paper.

The 220 power amplifier will appear in a subsequent issue of *73 Magazine.*■

Coil Tap Mystery

Many hams throw up their hands when it comes to determining the position of a tap on a coil. In many cases, the tap impedance must match that of the following stage. Many hams who understand why the tap is there, think, "That's fine. I can find the proper point if only I know the base impedance of the transistor, or the collector impedance." Mathematical analysis can dissuade almost anyone, but don't despair!—several aids are available.

The Impedance Nomogram, found in most handbooks, is practically indispensable for the RF builder. Better still are the cardboard reactance slide rules usually found in technical book stores.

AC or RF calculations are more complex. For example, you might want a capacitor coupling for an RF circuit, but you don't know which size capacitor to use. You can determine the size by relating the capacitor resistance to DC. Here the slide rule or Nomograph comes in handy. Since you know the frequency and you know what would be a tolerable resistance, you can line up the arrow with the frequency and look at the resistance scale adjacent to the capacitance scale. Select the capacitance that is opposite the lowest resistance you want.

We call the AC resistance "reactance" or "impedance." In a resonant circuit, to find a coil impedance, take the value of the capacitance that resonates with this circuit, set the rule to this frequency, and look up the reactance. In a circuit at resonance, the inductive and capacitive reactances are equal.

Often, instead of a tapped coil, you will find a capacitive divider across the coil with the tap at the junction of the two capacitors. The total capacitance of two capacitors in series can be compared to two resistors in parallel (the product of each over the sum of each):

$$C_{ST} = \frac{C_1 \times C_2}{C_1 + C_2}$$

After you get the resultant capacitance, use the slide rule to determine the reactance. You can find the reactance of each of the capacitors individually. See them as two resistors in a series across the coil, and you can visualize the proportions of voltage across the two resistors, i.e., frequency is 25 MHz. Two capacitors of 62 pF in series are across the coil. The reactance of the capacitors at that frequency is 100 ohms. The tap is at the 50 ohm point of the coil. Do not confuse this as the center of the coil, as the inductive reactance across the coil follows a square law rather than a linear law. The reactance of the coil at this point is ¼ of the total.

Coil Tap Loading

This is the meat of coil tapping! You might wish to make some changes in the bandwidth of the receiver section of your transverter. Possibly, if you are interested in only a portion of the band, you may want to sharpen the selectivity.

Occasionally, when tuning a capacitor for resonance, you find a really sharp peak. Another time you might find the capacitor to have a much broader peak. Why is this? You have seen resonant curves in handbooks. If the circuit Q is high, the curve will have steep sides and a narrow bandwidth at some point down the curve, usually the half power point (3 dB). Measure the frequency at the half-power point on the low frequency side of the peak and again on the high-frequency side. The difference in frequency will be the bandwidth. If the coil Q is low, the bandwidth will be greater than il the O is high.

How do you vary Q by tapping the coil? We can assume that in this circuit (a receiver RF amplifier stage) you don't know the collector impedance or the base impedance of the following stage. But you do know that there will be two taps on the coil, and that the taps will affect its Q and thus its selectivity or bandwidth. Here you have a coil and capacitor which will resonate this circuit at the desired frequency. If the coil wire is sufficiently large, and the coil diameter is ⅓ to ½, the length of the coil, the circuit should have a high O called "unloaded Q." The selectivity will be high and the bandwidth will be very narrow.

Now you have to get this combination into the circuit to do some work. Ground one side of the coil to make the low impedance point. You want to feed energy into the coil from the collector of the transistor of that stage. The collector impedance will load the Q of this coil. Il the impedance is high, you can connect it to the high end of the coil. The ideal point is where the Q drops to one-half. Though the ideal is not always possible, at any rate the bandwidth will increase. If the collector impedance is relatively low, you might wish to tap down the coil. Choose a point from ¼ to ½ down. Collector impedance of a bipolar transistor is generally higher than the base impedance of the following stage.

Let's say you decide on a point ⅓ down the number of coil turns. Now comes the real loading, getting energy from this tank circuit into the base of the following stage. The base tap will be much closer to the bottom or low impedance point of the coil. Place it ½ turn up from ground. Generally at this point it takes somewhat sophisticated equipment to determine what is truly happening.

A sweep frequency signal generator, a calibrated marker generator, and a spectrum analyzer are used in the design laboratory. But when these are not available, there are other ways to make a satisfactory measurement. An RF vacuum tube voltmeter can really help.

Sending a steady signal into the receiver and using some type of indicator, possibly an S-meter on the transceiver, the capacitor is tuned to resonance. If the tuning is sharp, you know the bandwidth will be limited. Tapping the base further up on the coil will load the coil more heavily, and cut down the selectivity, because the tuning will be broader, and the receiver will cover a wider frequency range. One point: the further down the coil (toward ground) that you place the collector tap, the more stable the circuit; but circuit gain will be reduced.■

TS-940/Transverter Jack-Pin numbers

8-pin DIN pin number	Function
1	Ground
2	PTT to transverter (12VDC @ 50 mA max.)
3	Ground
4	TS-940 Final Amplifier disable (Ground from transverter)
5	Received (input) signal from transverter
6	ALC from TS-940 (not used here)
7	Transmitted (output) signal to transverter
8	Internal TS-940 HF signal—connect to pin 5 to restore TS-940 HF when transverter off.

Table 4.

Cheap and Dirty Oscillator

An audio frequency source for pennies

by Dave Marling VE1VQ

As long as it still works like the experimenter would want it to, simple is always best! Take electronics test equipment. Why build a complicated piece of test gear when a simple one will do the same job? This project costs less, is easier to put together, and less likely to fail.

The audio oscillator in this article serves to illustrate this point. It couldn't get much simpler. Don't forget that the output is far from being a sine or square wave. This project is simple and functional, not laboratory grade.

Circuit Operation

When switch S1 is closed, voltage is connected to the circuit through the diode CR1. Resistors R1 and R2 act as a voltage divider initially holding the base of transistor Q1 (PNP) and the collector of Q2 (NPN) to 6 volts. Capacitor C2 begins to charge through R3. When the voltage across C2 reaches about 6.7 volts, Q1 turns on. This forces the base of Q2 high, turning on Q2. The emitter of the second transistor goes high and since the output is taken from across R5 this also goes high. When Q2 switches on, the output resistor R5 is effectively placed across the PNP base resistor R2 to ground.

Now Q1 base voltage drops from 6 to about 3.6 volts turning on Q1 even harder. C2 starts to discharge through R4 until the voltage across the capacitor is less than the 0.7-volt difference required across the base-emitter junction needed to keep the transistor turned on. Q1 turns off. Q2 turns off. The output goes low. Q1 base voltage returns to 6 volts and the whole thing starts again. Eureka—an oscillator!

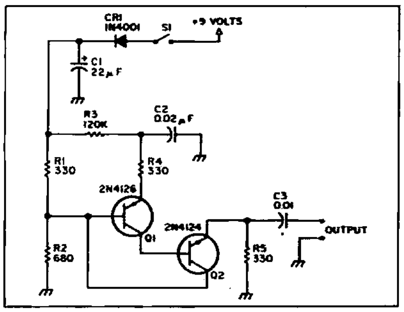


Figure 1. Resistors are ¼ watt.

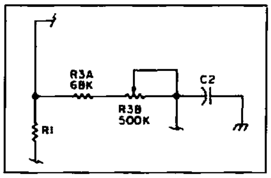


Figure 2. A 500kΩ volume control with a switch can replace S1 and R3.

The transistors are not critical. PNP and NPN types with fiT's of between 200 MHz and 1.1 GHz, plastic low power, metal signal, RF power output, and even a couple of unmarked TO-3's were tried, and all worked fine with very little difference in the frequency.

Two components do affect the frequency. Make R3 smaller and frequency goes up. Make C2 larger and it goes down.

Voltage is another non-critical. Varying the supply voltage from 4.5 to 15 volts changed the frequency somewhat but oscillator start-up occured every time power was switched off and on.

If money is no object, make this thing variable by changing the value of R3 to 68kΩ and adding a 500kΩ potentiometer in series.

As mentioned before, the output has a definite lack of purity. The waveform is actually a spike with a repetition rate of about a thousand hertz. If the experimenter views the output on an oscilloscope he will see all kinds of fuzz and garbage along with the original one kilohertz pulse.

Uses

In the bygone days of ham radio when the experimenter used to fix his own stuff instead of shipping it back to the importer, one of the more indispensable pieces of test gear was the signal injector. Starting at the speaker in a receiver or audio amplifier and working backward along the signal path with the injector, the defective stage was found when the signal disappeared.

All of that garbage from the oscillator actually has some use. While checking the audio stages, the 1000 Hz comes through. Once into the IF and RF sections the fuzz shows its true stuff. The oscillator has usable output out beyond 30 MHz.

I run a burglar alarm business. One of the things that makes the alarms ring in the night is the four-wire cable that runs from each of the many sensors to the alarm panel. Things go fine until a couple dozen of these come through a hole in the back of the panel and the ID tags have fallen off half of them. What to do? Connect the output of the oscillator to two of the four wires in one of the lines at the far end of the run. Back at the panel I check out the unknowns by listening to each in turn with a small battery powered audio amp.

How about a code practice oscillator? Simply connect a key in series between the output capacitor C3 and an audio amp and pound away.

Simple test equipment–simple to build, simple to get working and simple to use with all kinds of uses. That's the best kind!

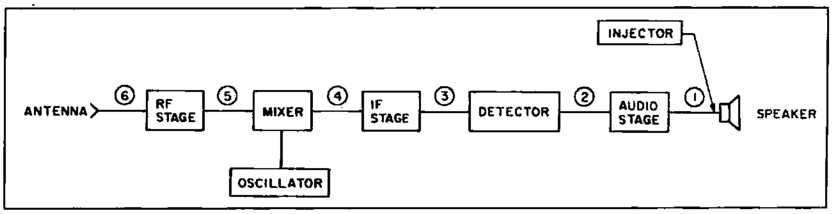


Figure 3. Move the oscillator output from test point 1 through to test point 6. Output from the speaker should increase as the experimenter gets closer to the antenna connector, because of the gain in each stage.

Number 10 on your Feedback card

73 Review

by W.S. Gardiner VE6BGL

AutoSketch and Amateur Radio

Inexpensive CAD program for both shack and home.

AutoDesk Inc.
2320 Marinship Way
Sausalito CA 94965
415-332-2344
Price Class: $80

Last April, I bit the bullet and went shopping for a new computer because the old one was, well, *old!* I snuck the new beast through the door with the usual ham stories: it'll be great for word processing, the kids will use it, computer literacy is important, etc. The XYL had probably figured out that the new computer would soon be spewing out RTTY or Morse dit-dah beeps! I gave the old computer to the kids, and they and the neighbors' kids are now happily shooting Martian invaders.

Software was next. The local BBS system had a bunch, and I soon became interested in graphics programs for drawing circuit boards. However, the BBS software couldn't do the job. The commercial stuff could do the job, and had features galore, such as auto-routing, sixteen-layer handling, pretty colors; all explained by manuals as thick as phone books. These programs, however, would put a dent in anybody's wallet.

Little Brother Does the Job

Onto the scene creeps AutoSketch. This is the low-buck brother of AutoCAD the industry standard. AutoCAD costs—well, let's say it's not in my budget, while the list price of AutoSketch is affordable at under $100. It doesn't have all the features of AutoCAD, but does a noble job just the same!

So far, I have used it for the chassis layout, a circuit board design, some furniture arranging, and guy wire calculations. Chassis layout is particularly neat. (See Figure 1.) After you draw a box layout like this one, you can use the AutoSketch STRETCH feature to make the box longer or wider. The dimensions are automatically recalculated! You can also change the size of the box by scaling it up and down when you plot it on the printer. With enough computer paper on hand, it would be possible to lay out a full-size floor plan of the Queen Mary, paste the strips together, and start building from your plans.

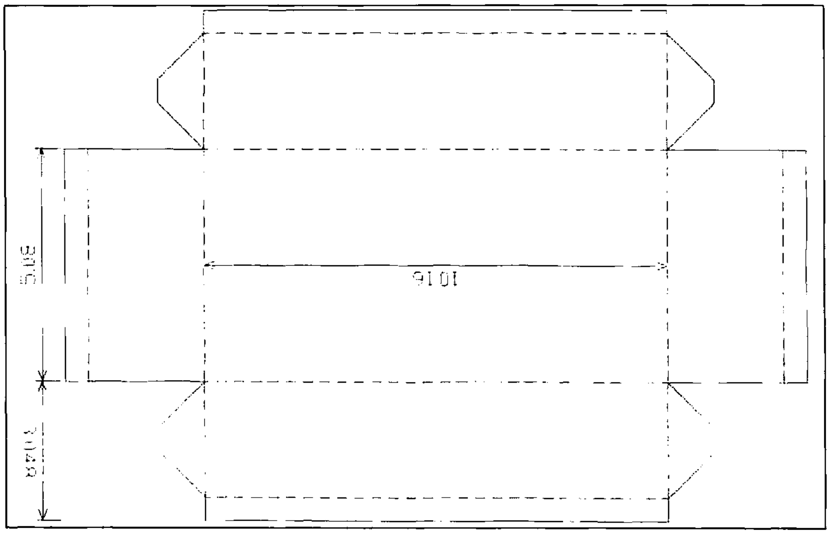


Figure 1. AutoSketch drawing of a chassis.

Commanding Designs

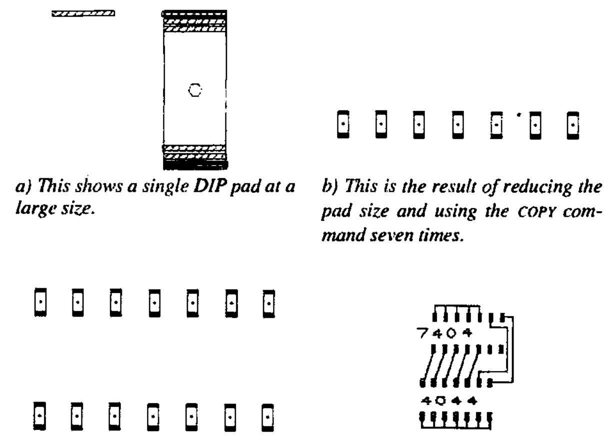
Circuit board layout is easy with AutoSketch. Until now, I drew all my layouts on 0.1" graph paper and transferred the finished design onto copper. This meant a lot of time-consuming erasing. AutoSketch has a GRID feature you can set to 0.1" x 0.1". A series of dots appear exactly 0.1" apart. MOVE, COPY, and MIRROR commands make drawing a 14-pin DIP socket a breeze. I drew one pad, used COPY to copy it seven times, then GROUP so the computer would treat it as a unit, and MIRROR to create a finished PART. (See Figure 2.)

Once you have created a PART, you can add it to other drawings, or move, copy, or modify it. You can create a PART library for frequent use. Just pull them up from the menu, put them in position, and keep going! Talk about fast!

AutoSketch for Home and Shack

Remember when the XYL wanted to move the piano? You lugged it all the way over by the begonia planter, and it wouldn't fit! Well, have I got a tool for you. First, measure the room and everything in it. Next, use AutoSketch to draw a floor plan, complete with the objects in the room. You can move them around on the screen first!

For example, you might be deciding on where to put the operating desk and chair for your new shack. Draw the desk and chair on the floor plan, along with all the windows, doors, closets, etc. Then you can MOVE the



a) This shows a single DIP pad at a large size.

b) This is the result of reducing the pad size and using the COPY command seven times.

c) Using the MIRROR command on the seven-pad row gives this image.

d) The final product. This can be copied and placed anywhere on the PCB layout diagram.

Figure 2. Using AutoSketch to draw a 14-pin DIP socket for PC board layout.

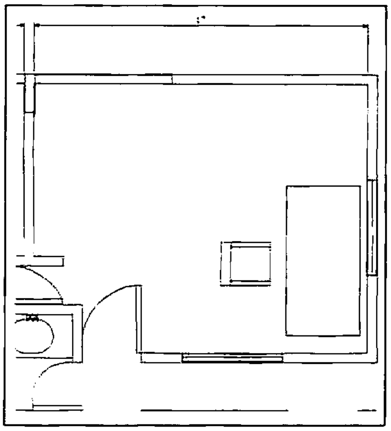


Figure 3. Room layout. AutoSketch can reposition components in the room, such as the desk and chair (lower right).

furniture around on the computer screen with ease. ROTATE lets you turn the chair or desk around to any angle, and MEASURE tells you the distance between two specified points. The ANGLE command is, of course, for angles, and AREA/PERIMETER figures out how much carpet you'll need for your dream shack!

How about guy wires for the tower outside? Again, draw a plan, move the lines around on the screen until they look OK, then use the MEASURE/ANGLE feature to do the calculations. Simple! If you make a mistake, AutoSketch has an UNDO command to fix up the blunders.

The Computer and Printer

A couple of hints: Leave about 100K workspace on your disk to allow the program to store data. If the program suddenly stops printing, the disk is probably full. My copy of AutoSketch has a read-me file with instructions for using dot matrix printers, which I should have read first!

You can print big drawings in sections and tape them together. Remember that a box of computer paper is 8-1/2" wide by several hundred feet long. You could draw a full-size wall section of the new house!

To use AutoSketch you will need an IBM compatible computer (512K minimum) with two 5¼" disk drives, and a Hercules, EGA or CGA monitor. I recommend a mouse, but you may use keyboard control. You'll also need a plotter or dot-matrix printer. I use an Epson FX86e. The program is very fussy about what it talks to, and if you aren't sure that your printer is compatible, take it with you to the computer store and try it out before buying.

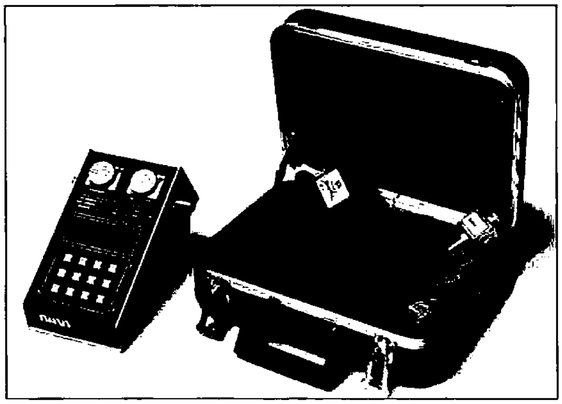
A final word to my drafting teacher way back in Grade 10, who never liked my arrowheads, who said I never could center a drawing, who despised my lettering . . . Hah!

73 Review *by Larry R. Antonuk WB9RRT*

Bird Model 4381 RF Wattmeter

Complement to the trusty 43.

Bird Electronic Corporation
30303 Aurora Road
Cleveland (Solon) OH 44139
Price Class: $695



Anyone who has worked his way up through the two-way radio business is intimately familiar with the Bird Model 43 Thruline® Wattmeter. The "Bird" is found next to every toolbox, on every bench, in permanent installations, and anywhere where there's RF. Have lunch with a few old-timers in the land mobile industry, and you're bound to hear stories about the time "the Bird fell from the seventy-foot mark on the tower and survived," or how "when I started out in this business, I had nothing but a box of fuses, a tube caddy, and a Bird." Tough, portable, and accurate... "take my wife, take my car, but keep your hands off my Thruline"... the Bird would never let you down.

New Bird Model 4381

Progress, of course, did not stop with wattmeters. The Bird Model 4381 Thruline wattmeter is one of the latest high-tech additions to the Bird line; the new kid on the block. Boasting a dazzling array of bells and whistles, the 4381 is quite a contender. (It needs to be, considering how firmly entrenched the incumbent is!)

The Model 4381 is the next logical step in the Bird line. It makes use of a similar 50Ω line section, with the same "Quick-Change" connectors, and the same power sensing elements. In a move totally contrary to industry trends, Bird designed a new product that uses the same "slugs" that we've been using in the Model 43 for years. This means that the 4381 can make use of existing inventories of elements, which keeps the cost lower and ensures compatibility with all the other Birds (and Bird clones) in the shop.

The 4381 uses two "slugs" at once—one at a given power level to sense forward power, and a second at one-tenth of the power level of the first to sense reflected power. The ten-to-one ratio provides higher resolution when sensing reflected power, and allows the unit to provide instantaneous SWR readings, or forward or reverse power, at the touch of a button. If the convenience of one-touch readings is not necessary, it's perfectly OK to use only one element, and manually reverse it to read reflected power.

Past the RF Sensor

Once past the RF-sensing portion, all similarities cease. The 4381 is housed in a slant-front table-top case, the two elements fit near the top, the digital read-out is in the middle, and the multi-function keypad is near the bottom.

The keypad selects the current operating mode of the device. Hit the FWD CW button, and you're reading the continuous wave power going in the forward direction—forward being the direction that the arrow on the element in the forward socket is pointing. All in all, the unit will read CW or PEP power in watts, milliwatts, or kilowatts from 2.5 to 1000 units in the forward direction, and 0.25 to 100 units in the reverse direction. SWR can be directly read from 1.00 to 99.99, modulation percentage from 0.0 to 99.9, and return loss over the range of 0 to 36.1 dB. For convenience, you can display forward and reflected power as dBm. As a bonus, the 4381 provides two types of useful over-range features.

To begin with, you can read each element up to 120% of its stated range. In other words, the 100 watt slug can now read up to 120 watts, and with higher accuracy, than switching to the next higher element and reading it on the low end of the scale. Furthermore, when used with the dBm mode, sensing elements can be over-ranged by 6 dB (or 400%). This means that you can actually measure up to 400 watts with the 100 watt slug if you're willing to convert from dBm to watts yourself!

The digital read-out will probably be seen as both a blessing and a curse. On the one hand, if the radio is supposed to put out fifty watts, there's no question that 49.8 is pretty close, but it's not fifty watts regardless of how cross-eyed you look at the display. On the other hand, some techs might spend the whole afternoon getting a radio from 50.0 to 50.2 watts—yes, it is higher, but so what? The bottom line concerns the actual accuracy of the unit.

Accuracy

As we should all know by now, accuracy is a function of the sensing device, and not simply the number of decimal places in the display. In this case, since the elements are the same as those on the good ol' Bird, the power accuracy is the same as the good ol' Bird: +/−5% full scale. (Using the two-element, ten-to-one ratio system, the reflected element, being closer to the value of the reflected power, will provide higher resolution and more accurate SWR readings than would be obtained by simply reversing the high-power element to read reflected power.) The display uses a "greater than/less than" symbol in place of the last digit to indicate increasing or decreasing levels. Used in conjunction with a MIN/MAX level memory, the "delta" function makes transmitter tuning a snap. (A snap, perhaps, but still not quite as comforting as watching that needle swing back and forth...)

The 4381 runs on NiCd batteries. One charge is good for about eight hours. This makes it portable, of course, but the unit is obviously meant to spend its life sitting on a bench. The digital display is certainly more shock-proof than the Model 43's meter movement. Lacking any sort of a handle, however, the 4381 will probably not find its way up too many seventy-foot towers. The higher price tag will probably ensure that the unit stays in the shack—or at least carefully guarded during Field Day.

Versatile and Compatible

After all the dust has settled, the contest ends in a draw. The 4381 performs many functions not available with the standard line of wattmeters—it measures SWR, peak power, and greater over-range. Due to its capabilities and size, the 4381 will find greater use on the test bench, in a production facility, or in a base station. Due to its portability and lower cost, the 43 (and the 43 series) will continue to be used in the field and in situations where economics play a greater role. Rather than the newcomer ousting the old-timer, Bird has provided us with a competent and experienced father and son team.

INEXPENSIVE MARKER GENERATOR

Calibrate and stay in band.

by Ron Wong WB6DFQ

A device capable of generating marker signals at precise intervals throughout the HF spectrum is a handy device to have around the shack. Amateurs can use this simple generator to calibrate receivers and identify band edges. By providing marker signals at precise intervals, the generator helps the radio amateur verify that he is operating within the prescribed band limits of his license.

The circuit shown in Figure 1 is just such a beast. It is capable of generating signals at 1 MHz, 100 kHz, 50 kHz, and 25 kHz intervals. Most of the parts for this project are inexpensive and available at any local Radio Shack store. Beginners can handle the construction of this project with good results.

Circuit Description

The oscillator section uses three sections of a 7400 quad NAND gate integrated circuit. The 1 MHz signal from the oscillator is fed into a 7490 decade counter configured to divide by ten, providing the 100 kHz signal. To obtain the 50 and 25 kHz outputs, the 100 kHz signal is further divided by a 7473 dual J-K flip-flop. The first half of the 7473 divides the 100 kHz signal by two, yielding the 50 kHz signal. The second half of the 7473 again divides by two, giving the 25 kHz signal. S-2 selects the output, a square wave rich in harmonics.

The generator may be powered from any convenient 6 to 12 DC volt source. A 7805 fixed voltage regulator supplies the regulated voltage for the oscillator and the divider chips. The generator described here is powered by a 9-volt transistor radio battery.

Construction

Construction of the generator is not critical. The entire unit is built on a Radio Shack multi-purpose board (276-150). This board has two bus strips at the center, and the PC pattern printed on the board is indexed to accept integrated circuits. The components mount on the board with ample room. Other construction techniques are acceptable, such as Vectorboard and flea clips.

I mounted the Radio Shack board in a small 2½" x 4" x 2½" chassis box, with a small on/off toggle switch (S-1) and a rotary switch (S-2) on the front panel. On the rear panel, I used a binding post (J-1) for the output. Inside the box, I placed a Radio Shack 270-326 battery holder for mounting the battery.

Operation

After you build the generator, you will need to calibrate it. The easiest way to do this is to use a receiver capable of receiving WWV at 5, 10, 15, or 20 MHz.

Tune WWV and couple the output of the generator to the antenna terminal of the receiver. Turn on the generator, set S-2 to the 1 MHz position, and adjust C-1 until it zero-beats with WWV. The marker signal should be very strong. If the 1 MHz signal blocks the receiver, loosen the coupling to the antenna terminal, or go to another marker position. You should hear the marker signals well into the VHF region. ■

Photo A. The finished project. The entire unit is housed in a chassis box purchased at a local flea market.

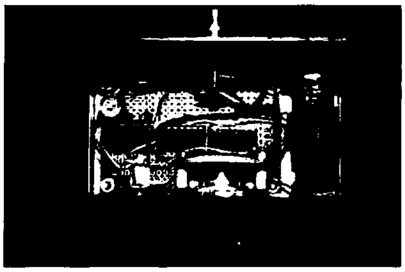


Photo B. The components are mounted on a Radio Shack multi-purpose board (276-150) and wired breadboard style.

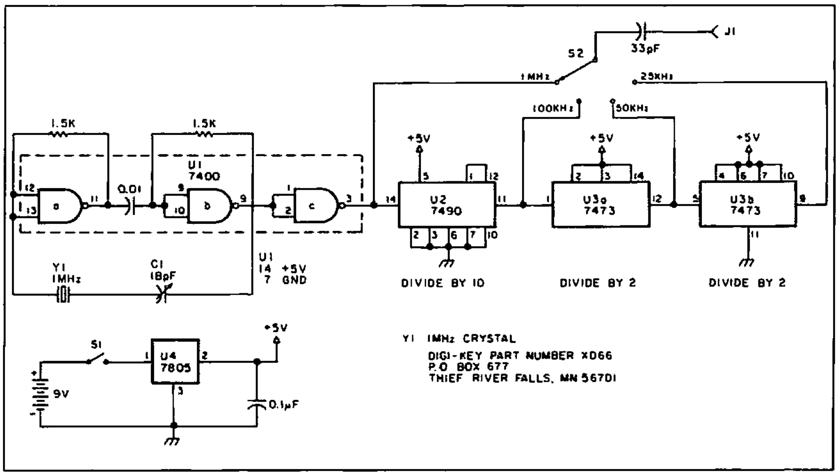


Figure 1. Marker generator schematic.

73 Review

by Fred R. Sharp W8ASF

Heath Company
Hill Top Road
St. Joseph, MI 49085
1-800-444-3284
Price Class: $400

VisiTel On-The-Air

A visual phone display you can interface with your transceiver.

Looks like we may finally have affordable SSTV after all, and better yet, something we can share with the XYL (or OM). This is in the form of the Mitsubishi VisiTel visual telephone display system.

The Mitsubishi VisiTel visual telephone display.

Here's Looking At You

The VisiTel is a complete black and white SSTV transceiver designed for telephone service. It comes with a husky line cord power adapter ready to plug in to a modular telephone jack. The compact unit measures 6¾" x 6¾" x 7" and weighs 3½ pounds. It features a built-in 4½" monochrome monitor with miniature fixed-focus vidicon camera. The size of the image is 3¼" x 2½".

Installing and Using VisiTel

This is very simple. Just plug the VisiTel cable into your phone line, and plug your telephone into the VisiTel, and send pictures of the kids to Grandma in Los Angeles or Greece! Of course, Grandma will need a VisiTel to receive your transmission.

To operate the VisiTel, merely slide the camera tube cover to the side, exposing the camera tube. Next, push the SEND button to transmit your picture. It takes 5.5 seconds to send a picture in 90 x 90 pixels at 32 shades of gray. While the pixel and line count is not high, the good gray scale makes up for it. You're better off with more shades of gray and less pixels than vice versa—ask any slow-scanner.

Neat Feature

The VisiTel stores in memory the last three images received as long as the unit is turned on. It kicks the first memorized image out of memory when a fourth image goes into memory. To scroll through the picture memory bank, repeatedly press the VIEW/POSE button. You can send the same picture more than once from the memory. After displaying or sending the stored picture sequence, the VisiTel screen once again displays the user's live image.

The brightness control (up and down) keys enable the user to adjust the contrast in relation to ambient lighting. The keys affect the picture as it is displayed and received.

Interfacing VisiTel and Your Transceiver

The unit interfaces with any VHF or HF transceiver, so you can send and receive the same pictures on the air or record them on audio tape for playback. The other night, for example, Rick WB8RTK and I were sending pictures back and forth on 2 meters.

Since VisiTel uses the same red and green telephone lines for both sending and receiving, you have to couple the transceiver audio through a capacitor. A simple hookup is shown in Figure 1 with the green line as ground.

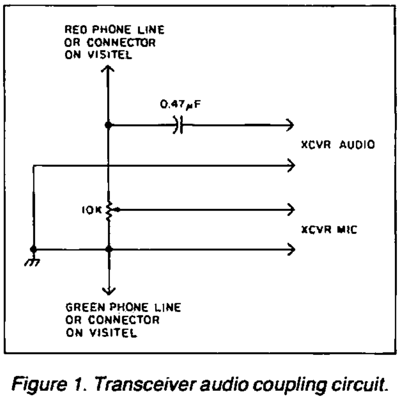


Figure 1. Transceiver audio coupling circuit.

Leave everything as it is for receiving, but for transmitting, you'll have to use your SEND/RECEIVE switch to turn on your carrier before pushing the SEND button. I installed a pot to adjust the output to about 1 volt. Radio aShack's #279-355 quick connect jack is ideal for housing the pot and capacitor. The box contains a modular telephone jack.

The ideal interface would key the VisiTel's push-to-talk line, and change from receive to transmit automatically when you press the SEND button. To sense the tone output of the VisiTel, I first tried using an optocoupler, and then I tried the 567 tone decoder chip, but neither method worked. The tone is present on both receive and transmit, which causes your rig to transmit on receive as well as on transmit. I decided it was impossible to interface without going inside the VisiTel.

Under the Cover

Three self-tapping screws free up the entire cover. Don't worry, no springs will jump out at you and no nuts will drop into some unreachable corner of the chassis. The mother board is easily recognizable and readily accessible, and just two connections are tack-soldered on top of the board. They are shown in Figure 2. They are +5 volts DC and ground.

You will notice that the interface in Figure 2 is the same as the one in Figure 1, except that its ground is common to the ground in the push-to-talk circuit. The interface draws about 3 mA maximum current so you can use #26 or even #30 wire-wrap wire. This size is very easy to thread through the expanded metal grill on the back of the unit.

Now you only need to connect one of the pins on the SEND switch. This requires further disassembly, but this is not a difficult

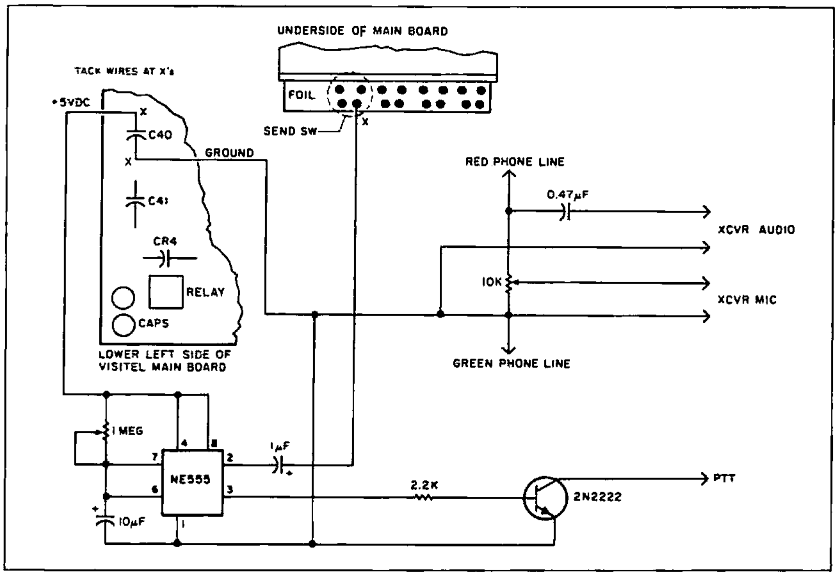


Figure 2. VisiTel/transceiver interface schematic.

procedure. When you have finished the 5 volt and ground connections, make this connection on the bottom of this same board. Free the board by removing the two large self-tapping screws from the edges of the metal cover that shields the foil side of the board. You don't have to take out all the little screws that hold this shield to the board. Fortunately, you make the connection on the exposed edge of the board, and not the part of the board covered by the shield.

The negative-going trigger pulse is applied to pin 2 through a 1 mF capacitor. The combination of the 10 mF capacitor (tantalum, please) and the 1 meg pot make up the RC network to set the time delay on the output at pin 3. Before pin 2 is triggered, pin 3 is low. When pin 2 is triggered, pin 3 goes high and turns on the 2N2222 transistor via the 2.2k base resistor. With the transistor emitter at ground and the collector connected to the transceiver push-to-talk, the transceiver is

"You're better off with more shades of gray and less pixels than vice versa..."

Remove the board by lifting sideways, disengaging the head pins from the connecting strip on the top side. You will see two white wires connected to the board which you do not need to remove. Tack-solder a wire to the SEND switch terminal as shown in Figure 2. This is a negative-going pulse which will trigger a 555 timer chip configured in the monostable mode. Bring this wire out with the +5 volt and ground wires. Re-insert the header pins in the connecting strip and fasten the two self- tapping screws. Before buttoning up the cabinet again, turn on the VisiTel and check for +5 volts, ground, and a negative-going pulse on the last wire tacked to the SEND switch. (A scope or logic probe will be helpful.) Close up the case, and you're ready to connect the interface as shown in Figure 2.

Operating the Interface

The operation of the interface is quite simple. You don't have to switch the red and green telephone lines. The push-to-talk circuit is just one way of using the miraculous 555 timer.

turned on for a period of time set by the RC network.

Because picture transmission time is 5.5 seconds, set the pot so that the transceiver is keyed on for about 6 seconds and then drops out. This setting is close to the center of the pot or around 500 kΩ. A little experimenting with pot settings will get the delay just right.

After you've made all the connections, plug everything in, open the VisiTel door, and get a picture on the monitor. Press the SEND button on the VisiTel and your push-to-talk will be keyed, and you'll be transmitting your picture. At the end of transmission, your push-to-talk relay will drop out and you'll be ready to receive.

Since the picture information is sent on a bandwidth of 3 kHz or less, you can transmit on any of the amateur frequencies permitting SSTV transmission, including HF. A little DIN plug or some such connector on the leads coming out of the VisiTel might be handy for quickly disconnecting the VisiTel when your XYL wants to use it to see her grandchildren in Sheboygan! Have fun!

WHICH END IS UP?

Stalking the shorted connector.

by Evert Fruitman W7RXV

The boss handed me a 4-foot coaxial cable and told me to replace the shorted end. Since he wouldn't settle for two 2-foot cables, one good and one bad, I would have to figure out which end had the short.

For a few minutes, we talked about using an RC bridge to find a break in a cable, and joked about replacing both ends of the cable, which would shorten it too much. Finally, we came up with the following idea.

Smart Thinking

Supply a fairly heavy current from a constant current source to the cable and measure the voltage drop at the end. The key here is that the the shorted end will have a lower voltage drop than the other end. The difference would be in millivolts but easily readable with a digital multimeter. Figure 1 shows the setup.

Apply the current to one end of the cable and connect a digital voltmeter directly to the cable end. Write down the reading; say, 70-150 mV. Then, without changing its setting, connect the current source and the meter to the other end of the cable and write down that reading, possibly 20-50 mV. The low reading indicates the end with the least resistance. Unless there is a pin in the cable, or the short is in the middle of the cable, the end showing the lowest voltage is the one with the problem in the fitting.

Sometimes, just applying a heavy current will burn the short out, especially if it was caused by just one strand of the fine wire used in many coaxial cables. Burning out a strand or two, however, may leave a carbon path on the cable. Even if the short clears up after you hit the cable with a couple of amps, redo the end for safety, depending on how you plan to use the cable. Especially take precautions for high frequency, high power applications. For low frequency, low power applications, it may not make much difference.

"The key here is that the the shorted end will have a lower voltage drop than the other end."

The Current-Limiting Power Source

Tying a 10-20 volt 2 amp power supply across a shorted cable could damage the power supply, the cable, or both. Finding a suitable current source is easier than it sounds. A good laboratory power supply, and many home-brew supplies, have a current-limit adjustment on the front panel. Set it for 1 or 2 amps and proceed as above. If your power supply will deliver 1-2 amps, but lacks a current-limiting circuit, add an external limiter. A large resistor or even a car headlight will do the job. Car headlights draw about 3 amps each on low beam and about 5 amps each on high beam at 13 volts. They make handy, high power resistors. Figure 2 shows the setup using a load (here, a resistor) to limit current.

While ¼ to ½ amp should furnish enough voltage drop to see on some voltmeters, the higher values will be easier to see, and they will more accurately indicate which end of the cable has the short.

Using this method, in minutes we had one cable the correct length and in service, and the shorted fitting in the waste basket. The boss was so pleased that he *almost* bought us lunch.

Perhaps the next time someone hands you a shorted cable, you will be able to tell which end is up.

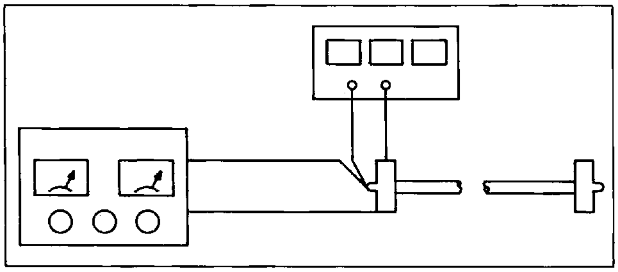


Figure 1. Basic setup to test cable. Power supply with built-in current-limiting set for 1-2 amps.

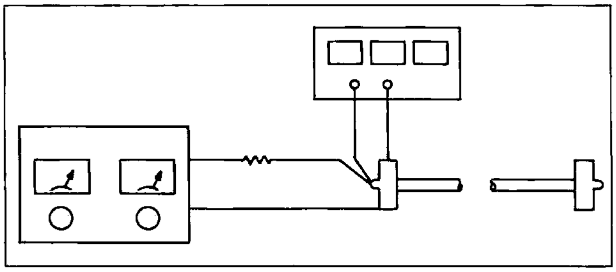


Figure 2. Setup with external current-limiting resistor. For a 1 amp 12 volt supply, use 10Ω 25 W resistor or car headlight.

Commodore 64 Voltage Protector

An inexpensive project, a valuable safeguard

by R.T. Saponas WØYJO

When you turn on your Commodore computer, do you ever have visions of the voltage regulator going bad in the power supply, ruining ICs? Put your worries to rest. Build a Commodore 64 Voltage Protector for less than twelve dollars.

The above unpleasantness appeared on my horizon one morning as I was working on a manuscript. The screen on my monitor blinked, filled with garbage, and then went black.

I checked the power supply. As I suspected, the 10.9 volt AC supply was still working, but the 5.08 volt DC supply was now a 10 volt DC supply. I don't have to tell you what happens when an IC designed for five volts receives double that!

After buying a new power supply and having the computer repaired, I spent some time looking through electronics magazines for voltage protection devices. I found several variations of "crowbar circuits" described by Jack Eschmann in the August 1979 issue of *73*; by Ken Wyat in the November 1982 issue of *73*; by W1SL in the August 1973 issue of *QST*; and by John Pelham in the October 1980 issue of *QST*. All I had to do was lay out an experimental circuit and make it work with the Commodore supply.

Of course any regulated power supply needs an excess voltage to regulate and is thus capable of destroying sensitive circuits it's powering. It doesn't take a lot of imagination to apply this idea and circuit to other situations.

Circuit Description

Variations of the basic crowbar circuit have been used for fifteen or more years in over-voltage protection devices for commercial equipment.

See Figure 1. You place a 1.5A fast-acting fuse—fifty percent over the C-64's requirement—in series with the 5.08 volt DC line. The silicon-controlled rectifier (SCR) is connected from the output of this fuse to ground.

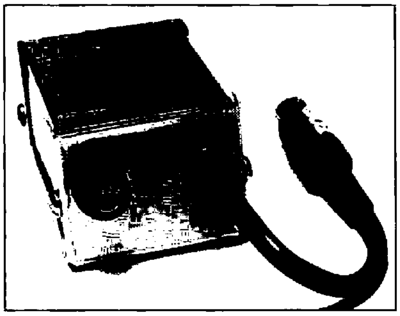


Photo A. The completed Commodore 64 Voltage Protector.

A 4.6 volt zener diode goes from the fuse output to ground through a 47Ω current-limiting resistor and a 1k resistor. Trigger voltage for the SCR is obtained from the junction of these two resistors. Use an 0.01 µF disc ceramic capacitor to bypass the gate of the SCR.

Should the DC voltage suddenly rise due to a failure in the Commodore power supply, the zener diode will start conducting. This will produce a trigger voltage on the gate of the SCR which causes the SCR to latch on. This shorts the output of the fuse to ground. The fuse will then blow, saving the computer's expensive ICs from destruction.

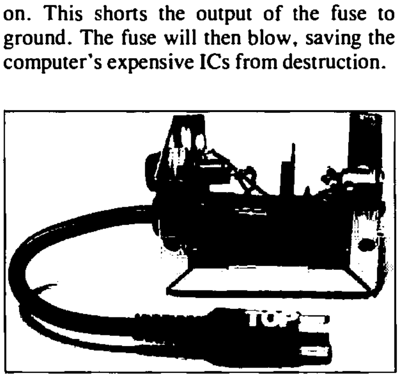


Photo B. The unit with the cover removed, showing the placement of the parts.

Construction

Begin construction by cutting the circuit board to size (see Figure 2). These dimensions allow adequate room to run the 10.8 volt AC leads under the circuit board. Drill the mounting holes in each corner. Next, use the board as a template to drill similar mounting holes in the bottom of the box. Make certain that the template is placed so that the spacing is even on all four sides. The holes in both the board and the bottom of the box should accommodate the four 6-32x½" mounting screws.

Now, prepare the circuit board for etching. Since all the traces are straight lines, you may use any method of masking. I covered the copper surface with masking tape, then used a razor blade to remove the tape from areas to be masked. Next, I applied a coat of fast drying enamel. After the enamel dried, I removed the masking tape between the sprayed areas. The board was now ready for the etching bath.

If etching a circuit board is distasteful to you, you can substitute a piece of perfboard of similar size, and hand-wire the circuit.

While waiting for the paint to dry, you can begin marking and drilling the front and back of the aluminum box for mounting the rubber grommet, the fuse, and the input DIN socket. Use a ⅜" drill for the grommet, a ½" drill for the fuse holder, and a ¾" punch for the DIN socket. If your shack doesn't have all of these tools, use the drills you have, then carefully ream out the holes with a small rat-tail file. If you use the Radio Shack fuse holder shown in the parts list, you will have to slightly enlarge the ½" hole. The manufacturer apparently used a metric measurement for this fuse-holder. Since these boxes are made of very soft aluminum, take care with the rat-tail file. A hole becomes large very rapidly.

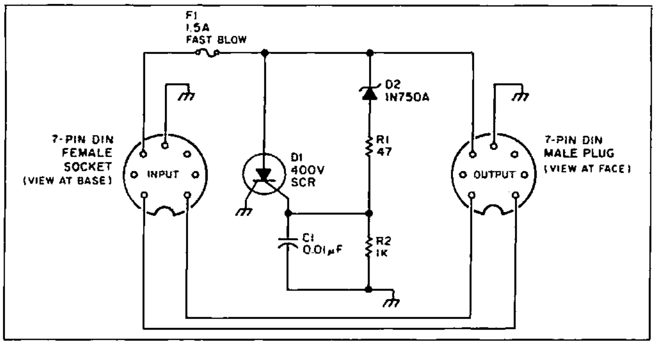


Figure 1. Schematic for the Commodore 64 Voltage Protector.

Parts List

C1	0.01 µF Ceramic	Radio Shack #272-131	$ .20
D1	400V-6A SCR	Radio Shack #276-1020	1.19
D2	1N750A Zener	4.7 V	.62
F1	1.5A Fuse (fast acting)	Radio Shack #270-1243	.35
R1	47Ω ½W	Radio Shack #271-009	.10
R2	1kΩ ½W	Radio Shack #271-023	.10
	Fuse Holder	Radio Shack #270-362	1.29
	Chassis Box (2¾" x 2⅛" x 1⅝")	Radio Shack #270-235	1.79
	Copper-clad board (2¼" x 1½")	Radio Shack #276-1591	1.00
	7-pin DIN socket		1.65
	7-pin DIN plug		1.85
	12" piece of 4-wire cable		.50

If you use fast-dry enamel, your circuit board should now be ready for the etchant bath. After you have etched and washed the board, bend the leads on the components and drill the holes as indicated in the parts layout sketch. Don't forget to drill one hole in the output trace and another hole near it, in the ground trace. Solder a 4" piece of wire in each of the holes. Later, you can cut these wires to the correct length and solder them to the input plug and to the fuse. Solder the components in place.

Mount the 7-pin socket with the socket key towards the top of the box. Next, solder the ends of the 12" piece of four-wire cable to the appropriate pins on the 7-pin plug. Strip five inches of the outer covering from the opposite end of this cable. Thread the cable through the ⅜" grommet, leaving the stripped portion inside the box. Dress and cut these wires so the two AC leads and the ground lead will lie under the circuit board after it is mounted. Solder these three leads to the proper pins of the input socket.

Mount the circuit board to the bottom of the box, using 6-32x½" machine screws and ¼" metal spacers.

Mount the fuse-holder. Solder a lead from the positive 5 volt pin on the input socket to the input side of the fuse holder.

Now, dress and cut the 4" DC lead, which you previously soldered to the circuit board, and solder it to the output side of the fuse holder. Do the same for the remaining ground lead from the circuit board, but solder it to the ground pin on the input socket. The unit is now ready for testing.

Testing and Troubleshooting

After you have finished assembling and wiring the Commodore 64 Voltage Protector, visually inspect it for wiring errors. The easiest error to make is to wire the input socket and the output plug improperly. At this point, it's a good idea to use an ohmmeter to check out this circuitry.

Apply a variable, current-limited DC voltage source to the output side of the fuse. With a voltmeter across the source, gradually raise the voltage from 5 volts until current-limiting causes the voltage to drop to zero. This means that the SCR has been triggered and is now shorting out the power supply. Turn off the power supply, and the SCR will drop out of conduction. The SCR should trigger at a point between 5.1 volts and 5.5 volts.

If you do not have a current-limited variable supply, you can make a fixed supply variable by using a potentiometer across the output. Use a 6 volt pilot lamp as an indicator of SCR firing. Solder two leads to the bulb and connect it across the fuse holder in your Protector. Remove the fuse from the fuse holder and apply voltage to the input side of the fuse holder. Again, place a voltmeter across the output voltage and gradually increase the voltage until the SCR triggers. The triggered SCR causes the pilot lamp to light, since it shorts one side of the pilot lamp to ground, placing it directly across the power supply.

If you use parts from your junk box, remember that the SCR and the zener diode are the critical parts. The tests above will help you determine if your components are okay.

After you have assured yourself that the unit is working, plug your regular Commodore power supply into it. Plug the unit into the computer, and you're ready to go. Always make certain to match the keys in plugs and sockets when you plug them together. If you force the plug into another position, you may short out your supply.

If the fuse in your Commodore Voltage Protector blows during normal operation, unplug the computer power supply from the wall socket and from the computer. Take it to your work bench and measure both the AC and the DC output voltages. If either voltage is missing, you need a new power supply. If the AC voltage is normal, but the DC voltage is 9 volts or higher, your Protector is doing its job. Buy a new supply and pat yourself on the back!

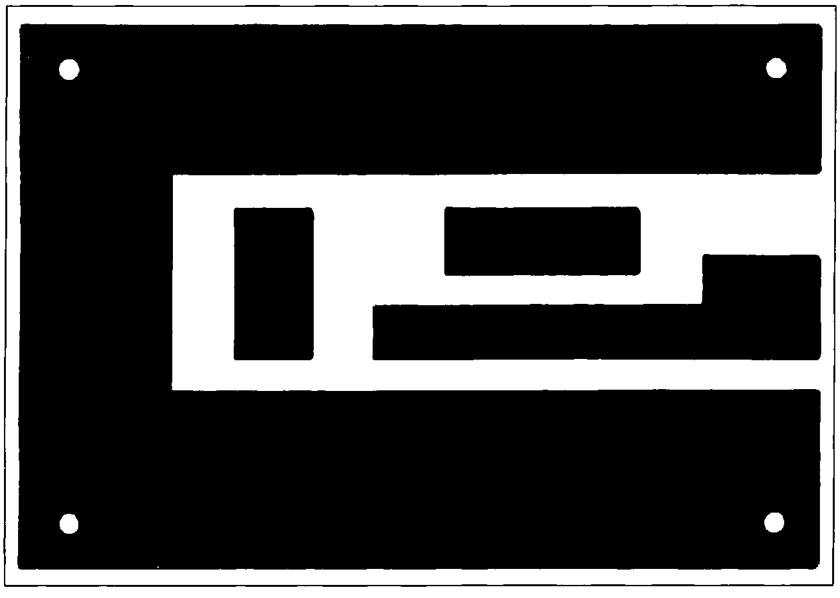


Figure 2. Full-size circuit board, foil side.

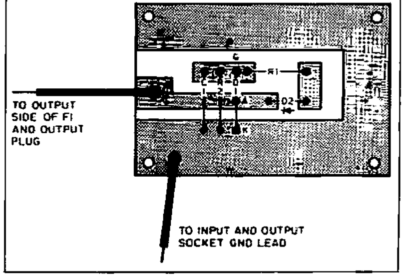


Figure 3. Parts placement layout guide.

The Hacker's Shack

Transceiver from a spectrum analyzer and tracking generator?

by Steven K. Roberts N4RVE

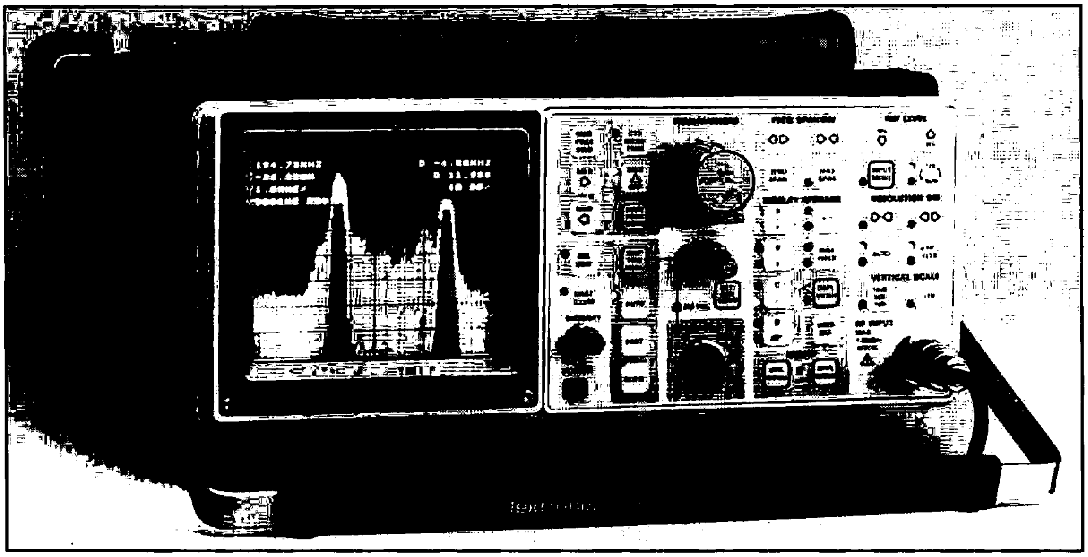


Photo A. Tektronix spectrum analyzer model 2710.

This is an interim of sorts—a time of misleading stability between bouts of nomadness. It's a respite from tire itch, a chance to develop a pot belly with unspent kilocalories, and a time to collect new equipment to further burden the already overloaded bicycle. Maggie and I are in a Silicon Valley layover, dedicated full-time to the creation of the Winnebiko III.

In the coming months, there will be plenty of space in these pages to discuss in satisfying detail the components of the new bicycle-mobile supershack. I've just started surgery on the multimode Ranger 3500 (for the 10 meter season is upon us), and many other strange projects are beginning as well. But I want to take a different approach this month, one inspired by the Hacker's Conference, rooms full of state-of-the-art test equipment, and a mad vision of future radio.

Bizarre and Colorful

A hacker, contrary to the recent slanderous allegations of CBS News, is not a computer criminal or some kind of evil-minded revolutionary. Those do exist, of course, but not in the subculture of creative genius that lies behind every new technology. A hacker, quite simply, is one who derives the greatest possible pleasure from circumventing limitations; a designer who leaps the boundaries of convention, pushes new ideas past the skeptical mainstream of an industry, and stays up all night in the wild-eyed fervor of creative insanity. Hackers are a bizarre and colorful bunch, and when I attended a whole conference of them in the Santa Cruz mountains this month, I witnessed an unrestrained intellectual energy that was almost frightening. It certainly seemed to frighten CBS...which showed images of my bike while speaking ominously of a band of revolutionaries gathered in the hills, plotting their next attack on the valley below.

The hacking phenomenon is generally associated with computers, for it has spawned such phenomena as the Mac, Hypermedia, and all manner of whiz-bang software and graphics magic. But any technology with a future is, by definition, eminently hackable...so let's consider the "radio hacker" and what his or her station might look like.

The Ultimate Rig?

First of all, let's agree on something. This rig has to be realistic, something you could assemble today. We're talking real technology here, not dreams of future offerings from the Big Three. The fantasy is that these tools will someday be available for less than the hundred grand that they would cost right now... One of our general requirements is total agility in the electromagnetic spectrum, along with the ability to generate and demodulate any communication mode. We should be able to track mysterious signals, even if they're drifting, and determine their spectral content. We need to freeze events in time, pretriggering if necessary. All types of signal encoding, analog or digital, should be emulated in software. There should be plenty of clean power to the legal limit, robust antennas, and convenience features such as total remote control and automated operation. And, to satisfy the hacker within, there must be endless reserve capability for trying out

new ideas and probing the limits of existing systems.

In a sense, any radio receiver is a spectrum analyzer, but one with a narrow window that moves with the cursor. What if we opened up the view of the spectrum, covering the famed "DC to daylight" range at any level of magnification? It turns out we don't have to invent this at all; they're available off the shelf from Tektronix and Hewlett-Packard.

One of the least expensive spectrum analyzers in this class also has some of the most interesting features. The Tektronix 2710 (see Photo A), covering the fairly modest range of 10 kHz to 1.8 GHz (most of their models go to 325 GHz), offers the interesting feature of demodulating any signal highlighted by the cursor, with AM, FM, and rasterized video the basic options. What if we take one of these analyzers and give it a high-gain tunable front end, a product detector, and a GPIB interface cable to a host computer? Do we have a passable receiver?

To find out, I spoke with a few Tek engineers, and sure enough, it's not a mad idea at all. In fact, Stan W7NI and Ken N6RO have dreams of making an all-Tektronix QSO between Portland and San Francisco using only off-the-shelf test equipment. The transmitter? How about a tracking generator that follows the spectrum analyzer's sweep, locked on frequency by setting the instrument to zero span during a QSO? I've watched the machine handle video, 2 meter FM, and AM broadcast with equal felicity. You just set the cursor to an interesting peak or a specific frequency and tell it to demodulate to a built-in speaker or the screen. All bands, all modes, any bandwidth, computer control, graphic user interface. . . not bad for $10,000!

Once a true hacker starts thinking like this and ignoring price, things rapidly get out of hand. By the time we add a broadband kilowatt linear, a full-size log periodic along with other appropriate antennas, and full remote control of the whole system via laptop computer and 9600-baud TNC. . . we have a pretty hard-core ham station.

A License to Tinker

In reality, of course, commercial spectrum analyzers are not optimized to perform as receivers. There are many features we have come to expect in communications gear, including IF passband tuning, and so on. But I suggest this not-entirely-absurd concept to make a point: we've grown so accustomed to buying special-purpose boxes to handle the essence of our hobby that the original spirit of ham radio has become almost vestigial, present only in the hard-core cadre of wizards and inventors who keep bringing us new toys.

It's a dangerous pattern. I've met a number of packeteers, for example, who really don't know what's going through those wires between computer, TNC, and HT, other than something vaguely defined as "data." While there's a lot to be said for a turnkey radio data communications technology available to the masses (I'm all for it), we hams carry a license to tinker. Even though this hardly constitutes an obligation, it sure as hell is a *pleasure* . . . and as the average intelligence and education of the American human slowly falls, we find ourselves in the position of being the only ones outside the engineering labs who can actually make electronics work. That the designers among us are on the decline, I find disturbing.

The energy at the Hackers' conference typified the spirit that should appear in the top 1-2% of ham radio operators: a mad, almost obsessive desire to build new systems (or make the old ones perform beyond the dreams of their creators). If this touches something within you, by all means. . . go for it!

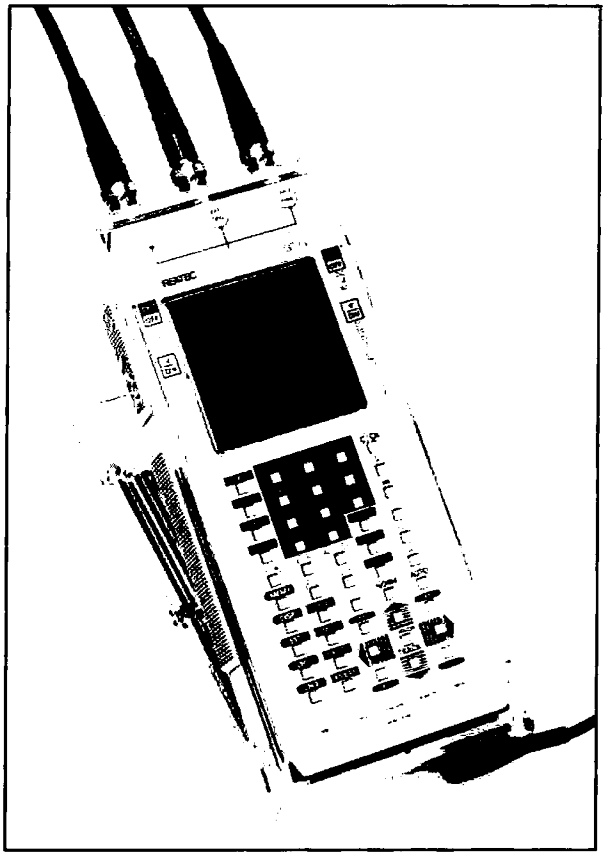


Photo B. The Createc SC02.

Radical Oscilloscopes

All this talk of test equipment reminds me: a few months back in these pages, I lamented that I carry no oscilloscope on the bike. That has finally changed. There are too many situations where the complexities of the system demand something a little more capable than a logic probe and multimeter.

The Createc SC02, shown in Photo B, is a West German marvel that packages, in less than 2 pounds, a complete dual-channel 20 MHz storage scope with 46 waveform memories. It can perform calculations between the incoming channels, or between either of them and any stored waveform. It has four cursors per channel, with digital read-out of their relative time and amplitude values. Ten "setup memories" allow you to recover weird configurations, and the 50-key keyboard lets you define every conceivable scope parameter with a structured command language. There is even a multimeter mode, which is more exciting than it sounds: a replica of the waveform is displayed in the lower right corner while the bulk of the screen presents a constantly updated table of peak-to-peak, zero-to-peak, average, RMS, period, and frequency. . . complete with calculated maximum error percentages based on the position of attenuators and various internal factors!

This unit is quite a departure from traditional oscilloscope designs, and the company is introducing a model early in 1989 that carries the concept to its logical conclusion: an optically-isolated RS-232 link will allow the SC04 to serve as a data-acquisition front end for digital signal processing, QC, or any other "smart instrumentation" application.

Power for the scope is provided through an external cable that carries +5 and +/−12, power easily derived from the existing switching supplies on the bike. I also carry a small AC supply for extended sieges at a bench, such as the one that's going on now. Interestingly, this little unit is so comfortable to operate and so easy on the eyes that I'm finding it preferable to traditional lab scopes, except in those rare cases when 20 MHz simply isn't enough bandwidth.

In next month's installment, we should have a look at an important part of the new bicycle-mobile ham shack, the Ranger 3500 10 meter rig. Until then, cheers from somewhere in the electromagnetic spectrum!

NOTE: For further information on the Createc SC02 hand-held oscilloscope, contact Ken Pine, Createc, 337 Kifer Road, Santa Clara, CA 95051; 408-738-3744.

For information on the Tektronix 2710 Spectrum Analyzer, call 800-835-9433 and ask for your nearest sales office.

Finally, my Computing Across America *book continues to be available for $9.95 plus $2 shipping from: Computing Across America, 1306 Ridgeway Ave, New Albany, IN 47150.*

73 Review

by Bryan Hastings NS1B

Number 16 on your Feedback card

Hamcall

Callsign info on your microcomputer.

Buckmaster Publishing
Whitehall
Rt 3, Box 56
Mineral VA 23117
(703) 894-5777
Price Class: $30/year
(long distance connect calls not included)

It was bound to happen. With the explosion of on-line services—into which anyone with a computer and a modem can call to get all kinds of information and perform all kinds of interactions, such as reading the up-to-the-hour UPI news, booking a plane ticket, or participating in one of hundreds of forums covering topics from (yes, Amateur radio!) to Zoology—someone would get around to putting a callsign information service on-line. This "someone" is Buckmaster Publishing, and the service is Hamcall.

Getting Set

After signing up for the service, Buckmaster sent me a page and a half of instructions. It supplied the necessary information for getting on-line and using the service. This included a five-digit password, access phone number, modem settings, and baud rates (Buckmaster supports 300, 1200, and 2400 baud modems), and extra help with the service, which is basically menu-driven.

Operation

I had to follow the instructions carefully when I first signed on. Unlike most on-line services, no introduction appears when Hamcall answers the call. As stated in the instruction sheet, the service waits for the user to send two returns in order to determine the user's system baud rate. (My system is a Standard Turbo 10 micro (a PC Turbo clone), BCN Smartlink II modem, and Crosstalk XVI communications software.)

The service then asked for my password (five digits). After having called in a few times, I discovered that it always tells you on the first entry that the password is incorrect, whether or not you entered it correctly. Typing in the password correctly the second time brought me to the next step, where it asked for my callsign. After giving that, I had access to the directory.

Operation was basic from then on. The service simply asked, "What Call:" After I gave it a callsign, it took a few moments to display the associated name and address, and then immediately repeated the query. When I gave it a call for which it had no information, it came up with "No Match." Typing "bye" signed me off the system. That's all there was to it!

Once I gained some facility with getting on the service, it took about two minutes to get to the directory, which cost between 50 cents and a dollar for the toll call.

HamCall vs. *Callbook*

There are three elements, or "fields," involved—callsign, name, and address. Both Hamcall and *The Callbook* have only the callsign as the search field, i.e. they are useful only to find an unknown address and/or name from a known callsign. On the down side, Hamcall gives information only on hams with US licenses. On the up side, Hamcall's directory is updated every month—compared to the *Callbook's* quarterly updates, which involves referencing up to four different sources (the yearly *Callbook* and three supplements). It also retains previous callsigns of upgraders for up to one year. Buckmaster flushes out the old calls every December. I changed my call from KA1HY to NS1B on 14 June, and Hamcall, in early October, produced my name and address under both calls.

Time and $$$ Considerations

Hamcall doesn't offer any real advantage to a ham who looks up only one or two calls every once in a while. US VHF and above contesters and DXers, WAS chasers, and others who need to find the addresses of many US licensed hams, however, would find Hamcall a real eye- and time-saver. Since the system operates in full-duplex mode (i.e., it can receive and transmit simultaneously), if you are equipped to do the same, you can lessen connect time by typing ahead of the service response. Just turn on the capture function to save to disk, and enter the calls one after another. Hamcall spends about 4–6 seconds per search for a callsign. One hundred searches thus means between 7–10 minutes of connect time. At ATT evening rates (35% off), this comes out to a maximum of $2 for the toll from anywhere in the US. With a little ingenuity, and the appropriate software, you can print out these addresses onto mailing labels and affix them to QSL cards!

Conclusion

Hamcall is convenient and easy to use, especially for those already familiar with the workings of micros and modems. Hopefully, Buckmaster Publishing plans to get international callsign information, and perhaps even name and address search field options, on-line in the not-too-distant future. (Until recently, Buckmaster published *Name and Geographical Index Callbooks*). All in all, however, Hamcall is a good start for a service very much needed in the ham community.

TROUBLESHOOTING GUIDE FOR SWITCHING POWER SUPPLIES

Trace the problem quickly with just a scope and a DC meter.

by Ed F. Rice W9NGP

Ever had trouble with your switching power supply, but didn't know where to start to find the problem? Well, the troubleshooting guide in Figure 4 presents a sequence of tests to follow when there is no output from a switching supply. It outlines strategic tests that quickly eliminate testing of whole sections of the circuitry at once, so the defect can be quickly isolated without the need to test a large number of individual components.

Switching supplies are subject to all the failures of conventional supplies: destruction of diodes in the input rectifier due to transients on the AC line; chokes, diodes, and transistors damaged by shorted load (because of the high efficiency of switching supplies, a shorted output results in a very high voltage elsewhere in the circuit); and overheating due to inadequate ventilation or skimpy heat sinks.

Switching Supply Components

The block diagram of a switching power supply in Figure 1 shows the overall relationships between the circuit divisions.

The input rectifier is often a simple ½-wave system which rectifies the line voltage and sends low voltage DC to the switch signal generator and the AC power switch. A bridge rectifier is used in high power units.

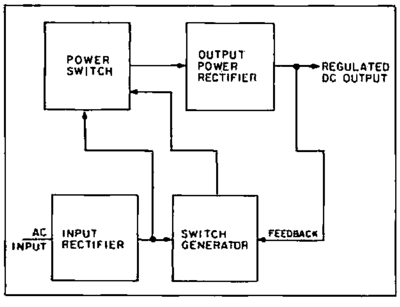


Figure 1. Box diagram of the relationships of the different circuits in a switching power supply.

The AC power switch is composed of a power MOSFET feeding the output choke and damper diode. The MOSFET is switched on and off at 50 kHz to 100 kHz by square waves of varying duty cycles applied to the gate. Regulation is accomplished by changing the duty cycle (not the frequency) to correct for variations in the output voltage. Figures 2a and 2b show a transformer-less single MOSFET circuit and a push-pull version used in high power supplies.

"It (the troubleshooting chart) outlines strategic tests that quickly eliminate testing of whole sections of the circuitry at once"

The output power rectifier, shown in Figure 3, is always a full wave center-tapped circuit in high power units. D3 is a type of damper diode which conducts when the field around the choke collapses, charging the output filter. This is the source of output power.

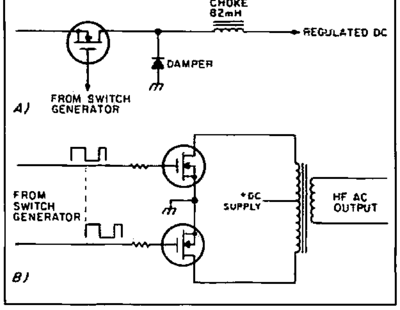


Figure 2. a) Transformer-less single MOSFET circuit. b) A push-pull version for high-power power supplies.

The combination of C3, R1, and D4 is called the "buffer" or "snubber" circuit. It shorts out the energy contained in the high voltage spike across the transformer secondary when the field collapses at MOSFET cutoff. An open diode, D4, can be disastrous to the transformer, MOSFETs, and diodes.

The switch signal generator is usually a chip containing a flip-flop, a comparator to sense the feedback, a soft-start circuit to protect the MOSFETs from being overdriven before the output voltage builds up, and shutdown circuitry in case of an overload.

Troubleshooting Strategy

When there is no output voltage, begin the process of troubleshooting by observing the waveshape at the gates of the MOSFETs.

As indicated on the chart in Figure 4, the result of this test divides the power supply into two parts and confines further testing to one-half of the circuits. If you find any waveshape at the gates when the output is zero, it is likely to be very distorted from the normal because the regulator will be straining to increase the output voltage.

The presence of any signal at the gates indicates that the input rectifier and the switch signal generator are probably working fine. This leads to a check of the DC voltage across the damper diode. A DC meter will not read accurately at this point because of the

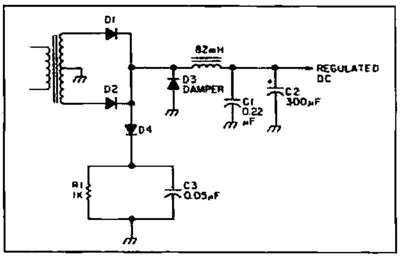


Figure 3. Schematic of the output power rectifier.

presence of an AC component. For most troubleshooting, at this point it is enough to know if DC is present or completely absent, so your meter will do the job. When you find a DC voltage across the damper, and there is no DC output, the chart in Figure 4 suggests three parts that could be defective.

If the damper voltage is missing, a check for the presence of any signal at the secondary of the power switching transformer is in order. As before, at the MOSFET gates, any signal at the secondary will be considered acceptable. The chart indicates three parts to check when there is a signal. And, if the signal is missing, the four possible causes of failure are shown.

"When no output voltage, begin troubleshooting at the gates of the MOSFETs."

The right side of the troubleshooting guide suggests a procedure when there is no signal at the MOSFET gates. It is not necessary to test anything in the power switch or output rectifier systems. Tests are confined to the input rectifier and the IC, beginning with a check of the input line fuse. This is followed by a test for DC input voltage to the chip.

Often, troubleshooting a switching type power supply is easy because the high power available leads to charring or total destruction of the components involved in the failure, and it may not be necessary to make many tests. However, even when the failure is not obvious, you can usually trace it quickly with a scope and a DC meter. 73

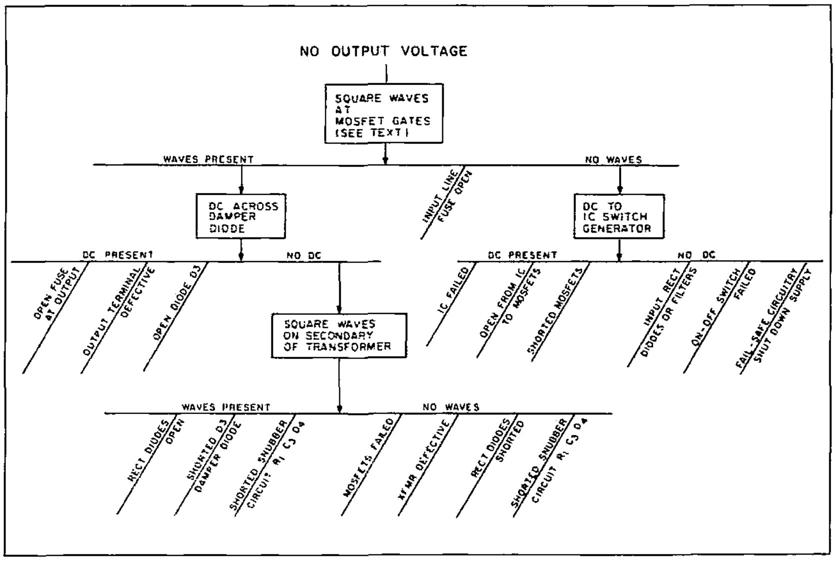


Figure 4. Troubleshooting guide for your switching power supply.

ATV

Ham Television

Mike Stone WBØQCD
PO Box H
Lowden IA 52255

75 Meter USATVS Net

Old man winter has arrived, and I hope all you UHFers in TV-land got a chance to install your hard-line, mast-mounted pre-amps and multi-element, high-gain antenna arrays before the cold weather hit. If you didn't, now is the time to do it! I also hope you had time to get your 75 meter dipole up in the air, pruned for the 3.871 MHz national ATV user's nel hotspot and DX coordinating frequency.

The USATVS sponsored net meets regularly every Tuesday night for about two to three hours, from 8 to 10 p.m. Eastern time. WB8ELK, WA4UMU, WBØZJP, and WBØQCD usually handle net control duties. Many ATVers use this HF frequency on week days, as well as on the weekends at night and in the early morning, during the best hours for band enhancement. So far, all states except California check in.

AAØP, WBØCZI, and the new Denver, Colorado, ATV troops talk cross-country into the Iowa BRATS, Indiana and Ohio ATCO group areas, while WA2OSW, W2RPO, and others in New York talk with W3SST, W3QNI, WA3USG, and the Pennsylvania group. WBØYNH, WA9NJR, and WBØQOX of the 3M Minnesota ATV Club exchange FSTV ideas with K4NHN and WA4UMU of the Palmetto, South Carolina, ATV group. Even W3LGV and W4PLA in the Orlando, Florida, ATV Club have talked about ham TV with WA8AHY, WA8ASH, WB8AMZ, and others in the Michigan area. It's a lot of fun keeping in touch with other ATV groups/clubs on a weekly schedule. The USA is finally uniting in the sharing of ideas and opinions, and helping to solve problems by coordinating on frequencies to work each other on video UHF TV mode.

New AEA FSTV-430 Transceiver

As hinted at in previous columns, a major amateur radio manufacturer has come out with a product in a new line of fast scan television gear. Advanced Electronics Applications, Inc., of Lynnwood, Washington, unveiled their new FSTV-430 model UHF 70 cm transceiver last September at the Virginia Beach, Virginia, and Portland, Oregon (National ARRL Conference), hamfests. I have known about this development since Dayton in April, but Mike Forsyth and Mike Lamb of AEA asked me to keep a lid on the information. It was tough to do, and a few who saw the smile on my face at local hamfests figured something was up.

No doubt Kenwood and ICOM will be watching the sales of this new piece of AEA gear, as they have already begun asking amateurs if they own a camera and VCR or not. Hopefully, AEA's introduction of reasonably priced, straightforward, and simple to operate fast scan TV equipment is the beginning of a new surge of interest in a mode that has yet to reach its prime in the ham world. This competition also forces existing ATV manufacturers to become more responsive to customers' needs. That has been a sought-after condition in ATV for a long, long time!

AEA's new FSTV-430 ATV transceiver is a crystal-controlled transmit and receive system. Two channels are available. The unit comes stocked with the popular 439.250 MHz national ATV calling and operating frequency. I wrote to AEA to ask them to take a second look at producing a tunable downconverter receive system, since many ATVers (especially DXers) monitor more than just one UHF frequency. Many also need to check both ends of the 70 cm band for the more than one hundred 421.250 MHz ATV repeaters in the country.

The unit comes standard with a 4.5 MHz FM audio subcarrier offset, and all the usual camera video and audio input connections. RF output power is 1 watt AM. Higher power amplifiers are readily available from Mirage, Tokyo Systems, Alinco, and others, to boost power from the new AEA exciter to a 20 or 50 watt level. I have asked to do *73 Magazine* and *Spec-Com Journal* reviews on this new product. By the time this column appears, the first finished models should be in the stores. Look for this hot, new item at Dayton in 1989. The October issue of *QST* and the November/December issue of *The Spec-Com Journal* 1988 carried the first information, with pictures, on the AEA FSTV-430 rig. Thank AEA for this new addition to an already impressive line of digital components! Who will be the first on your block to own one?

For Info On...

For Slot antenna information, contact Merle Reynolds W9DNT of Moline, Illinois, and Gerald Cromer K4NHN of Cayce, South Carolina.

Pauldon Associates (W2WHK, 210 Utica Street, Tonawanda NY 14150; 716-692-5451) has some interesting 400, 900, and 1200 MHz bricks, preamps, exciters, switchers, and power modules. We have one of their 10 watt amplifiers on our BRATS 910.25 MHz weather radar transmitter running twenty-four hours a day, and it works great! Send an SASE for a catalog of their products.

Rutland Arrays now has a new broadband, high-gain ATV modified K1FO 22-element 70 cm yagi antenna for $88.95. Contact Tom at 1703 Warren Street, New Cumberland PA 17070.

Don and Sue Miller of Wyman Research, PO Box 95, Waldron IN 46182, are promoting FM TV gear, and a new on-carrier sound TV receive module adapter for $90.

Welcome ATV Mode Newcomers

As AEA begins selling their new FSTV product, hundreds and hopefully thousands of new ATVers will be getting on the 70 cm band! AEA is counting on new ATV purchasers, not those already on ham TV. Most sales will hopefully be generated from this area. I agree with that. Therefore, to help AEA and *73 Magazine*, in the next issue of this column, I will begin a series of "newcomer" ATV articles. This might be a bit boring for you old-timers, so please be patient in your future reading. We need to go over ATV basics—how to get started, antennas and feedlines, and so forth, for the benefit of those who are just getting involved with ham TV. The future of this mode depends on it! ■

73 Book Review

The 1934 Official Short Wave Radio Manual

Gernsback classic reprinted for old-timers and young squirts alike.

Reviewed by Douglas Stivison NR1A

Lindsay Publications, Inc.
Box 12
Bradley, IL 60915-0012
(815) 468-3668
$14.95 (plus 75¢ shipping)
260 pages, paperback

The "Never Say Die" column has often lamented that, for many of us, the hobby just isn't as much fun as it used to be. Something very special was lost when we abandoned our home-brew rigs and tinkering skills in favor of the vastly superior performance of today's mass produced, high-performance transceivers. Certainly we gained mind-boggling performance, but somehow we lost our innocence in the process. And we lost the magic, the excitement, and the romance that always accompanies innocence.

Today we routinely fill our logbooks with 5-9 reports from the far corners of the world, but somehow the romance is gone. If we ourselves have forgotten the excitement and the magic of radio, it is no wonder that we can't convey these feelings to the next generation, and why we cannot attract newcomers to our ranks.

"Radio" Was Synonymous with Adventure

In the 1930s, however, things were entirely different, and the very word "radio" was synonymous with adventure and the call of faraway places. Technology was a lot simpler then and much more approachable. Time was plentiful, and if cash was hard to come by, there was no lack of ingenuity and scrounging to take over where the pocketbook left off.

Certainly no individual was a more powerful force behind the popularization of radio than Hugo Gernsback. In a variety of magazines, books, and contests, he not only showcased the excitement and romance of the burgeoning science, but he pioneered a style of nitty-gritty, how-to-do-it articles that have never been surpassed for their clarity or completeness. Circuits appearing in any Gernsback book were meant to be duplicated, and just about every radio tinkerer of the era had built at least one radio out of a Gernsback book.

Gernsback became better known for his publication of "pulp" science fiction, and to this day, the highest award a science fiction writer can win is the prestigious "Hugo" award named in his honor. But to a generation of radio amateurs, the Gernsback name is associated with a plethora of radio magazines. And of this range, *Radio Craft* and later *Short Wave Craft* were among the most enduring.

Hugo Gernsback's Classic

Lindsay Publications has come out with a reprint of Gernsback's classic *1934 Official Short Wave Radio Manual: Complete Experiments, Set Building, and Servicing Guide*. No longer is this gem just for the cognoscente able to pay the auction price at collectors' meets. No, today everyone can afford this fascinating and fully illustrated book.

> *"We routinely fill our logbooks with 5-9 reports from the far corners of the world, but somehow the romance is gone."*

The work was originally put out under Gernsback's *Short Wave Craft* label and it contains over 250 pages of classic how-to-do-it articles for a host of early radio projects. Everything, from one-tube regen receivers to 5 meter transmitters and receivers, is covered. Here are "portable" radios that look like they outweigh a typical Toyota.

This book is a road map through the lost world of grid leaks and tickler coils. It is like a time capsule, made when the hobby was going through one of its most exciting eras. There are also about a hundred schematics of the most popular commercial radios of the day, including such immortals as the Pilot Super-Wasp, the National NC-5 "Thrill Box" and the Hammarlund "Comet."

There are also some intriguing feature articles, including one by the late Don Wallace W6AM on improving antenna performance, and one by the legendary John Reinartz titled "A Receiver That Laughs at Static."

Not Just Nostalgia

But the book is much more than just a stroll down memory lane. Publisher T.J. Lindsay augments this reprint with a final chapter of totally new material, showing how to adapt the classic circuits in the book to construction using modern semiconductors for the original expensive and hard-to-find tubes. The book then becomes a hands-on build-it-yourself book, and I am sure that Gernsback himself would want it this way.

Without any heavy mathematical formulae (that would be totally out of keeping with the seat-of-the-pants tone of the original book), Lindsay lists his own experimentally determined values for modifying biasing components, "grid leaks," and coupling capacitors when substituting JFETs, such as the ubiquitous MPF102, for a wide variety of early triodes, and using dual gate MOSFETs, such as the workhorse 40673, for the popular screen-grid tetrodes.

Lindsay uses bipolar transistors as alternatives to early audio amplifiers. He gives a wealth of information on scrounging parts, and on building breadboards and cabinets to recreate the feel of the old radios. . .even if they are using modern semiconductors as the active devices. I feel that just this final chapter of seat-of-the-pants experience would justify the price of the book.

This is a great book for nostalgia fans who lived through the radio era of the early 1930s. It is an equally great book for those who were born later, but who are the heirs to the home-brewing and experimenting legacy that this era produced. And with the final chapter on building simple regenerative receivers with a combination of old and new parts, it is a gateway to building a circuit that is not sealed in a chip or wired by a robot on a Japanese assembly line. It is a hands-on guide to using radios that you actually build yourself. In fact, while reading Lindsay's comments on using a grid dipper, I could not help recalling hundreds of classic *73 Magazine* how-to-do-it articles by the likes of W6BLZ, W7OE, K5JKX, W1DTY and K1CLL in the 60s and early 70s.

For anyone who might have lost touch with the magic that first attracted them to our hobby, this book is a superb way to get the fires burning again.

Number 22 on your Feedback card

New Uses For Old Meters

Have the meter measure what you want it to.

by John R. Somers KC3YB

Recently, while I was assembling parts for a power supply I was building, I found I had everything I needed in my junk box except a suitable meter. While I had no shortage of meters of all shapes and sizes, I had nothing that would give me the right full-scale reading.

Inspecting the meter faces, I discovered many of them had, in addition to the scale markings, identification as to the type of movement they contained. Unfortunately, there seemed to be little standardization. Some of the meters indicated the amount of current required to give a full-scale indication, such as 0–1 mA, while others rated the movement in a certain number of ohms per volt. None of this seemed to have anything to do with the original function of the meter.

Meter Discoveries

With a little thinking about that most basic of formulae—Ohm's Law—I realized the current rating of the meter movement and the ohms-per-volt rating are intimately related. One is merely the reciprocal of the other! The number 1 divided by the full-scale current will result in the ohms-per-volt rating, and vice versa.

I then recalled that the value of a very low resistance shunted across the meter determines the range of an ammeter. A voltmeter has a much higher resistance in series with the meter for the same reason. This seemed simple enough until I realized the internal resistance of the meter would, in either case, be part of the circuit. Before I could determine the required resistance of either a shunt or multiplier, I was going to have to know the internal resistance of the meter. A quick check with an ohmmeter convinced me I was likely to burn up the internal workings of the meter before I could determine its resistance. How, then, was I going to do it?

A Full-Scale Meter Reading

To test the meter, I placed it in a circuit containing a battery and a variable resistor (R1 in Figure 1) that adjusts to limit the current flow to the point at which the meter gives a full-scale reading. I placed a second variable resistor, R2, across the meter to divert part of the current. When the meter reads half-scale, both meter and R2 present the same resistance to the current flow. Removing R2 from the circuit and measuring its resistance reveals the resistance of the meter movement. This is a simple system, complicated only by the fact that some meters have internal shunts or series resistors that must be removed before measuring the meter.

Meter Circuits

After selecting a meter that suited my application, I used the formula in Figure 2 to determine the shunt value I needed to add to produce a full-scale reading. Because a meter typically has a low internal resistance, the shunt value will generally be much smaller in value so that most of the current flows through the shunt rather than through the meter. This resistance may be 0.01Ω or less. A resistor of such a small value may not be easy to get, but you can make a perfectly workable substitute with a length of wire. Table 1 lists a number of common wire gauges and the resistance per foot. You can easily calculate the length of a wire you need to equal a desired resistance.

Remember to keep power-handling capability in mind. This will not generally pose a problem, but be on the safe side. Use the largest gauge wire you can. Although the table refers to bare wire, insulated wire can be used just as well. You can wind a wire shunt around a dowel and solder it to the meter terminals to conserve space.

The voltmeter circuit in Figure 3 uses a series or voltage multiplier resistor to extend the meter's range. In this case, a suitable external resistor will be easier to locate, as it will be many times the internal resistance of the meter. If you can't come up with the exact value you need, combine junk box resistors in whatever manner necessary to produce the desired resistance. In both circuits, meter polarity must be observed.

Calibrating Your Meter Circuit

Once you have completed the desired meter circuit, it must be calibrated before it is much good to you. The voltmeter is the easiest to calibrate accurately. Using a variable voltage source, connect the meter in parallel with another voltmeter of known accuracy across the supply. A digital voltmeter works best. As the voltage is adjusted, make light pencil marks on the face. Dry transfer numerals can then be added.

To calibrate the ammeter, place it in a series circuit that contains a known voltage and resistance. If you have a large, adjustable, wire wound power resistor, it will be perfect for the job. Otherwise, you can mix and match a handful of power resistors of various resistances to produce desired amounts of current flow. Make certain your resistors are up to the job.

Throughout this article, I have referred to voltmeters and ammeters. Actually, with proper shunt and multiplier resistances, your surplus meters can display a wide range of current or voltage readings, regardless of the uses for which they were originally designed. ■

References

1. *Radio Amateurs Handbook*, 1967.
2. *Allied Electronics Data Handbook*, 1966.

Resistance of Standard Annealed Copper Wire

Gauge	Ω per foot	Gauge	Ω per foot
4	0.0003	18	0.006
6	0.0004	20	0.010
8	0.0006	22	0.016
10	0.001	24	0.026
12	0.002	26	0.041
14	0.003	28	0.065
16	0.004	30	0.103

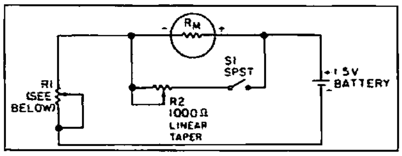


Figure 1. A simple circuit for determining the internal resistance of a meter. R1 is a 100kΩ linear-taper variable resistor. If full-scale current of the meter is known, the following formula yields greater accuracy:

$$R1 = 2x\ \frac{\text{battery voltage (Volts)}}{\text{full-scale meter current (Amps)}}$$

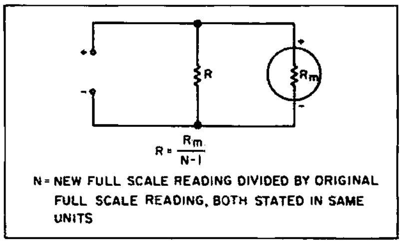


Figure 2. An ammeter circuit, and the formula for determining the shunt value for a meter of known internal resistance.

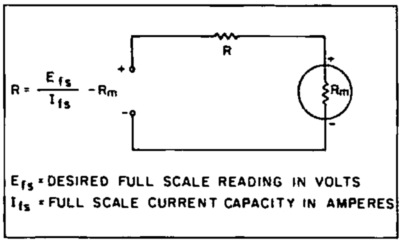


Figure 3. A voltmeter circuit, and the formula for determining the voltage multiplier resistance for a desired meter range.

Number 23 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D. WA3AJR
6 Jenny Lane
Baltimore, MD 21208

Trying Harder to Be Friendly

Let's begin right off with that traditional, friendly greeting that rings in your ears this season—HAPPY NEW YEAR!

Friendliness is an interesting concept, because this hobby of ours often exhibits two opposite poles of the emotion. Certainly many of us were brought into this hobby by a friend. The tradition of lending a helping hand, teaching each other, and kindling that amateur spirit makes amateur radio a unique hobby.

But often enough, this hobby of ours, with its wires, gizmos, blinking lights, and high-tech talk, can be downright unfriendly and even hostile. The facet of amateur radio that I write about, radioteletype and digital communications, may well be one of the hardest for the newcomer to get to know.

Of course, that's why I have been writing this column. One of my primary goals has been to convert technological gobbledygook into easy-to-understand concepts that leave the newcomer saying, "Oh, that's what it means." Long-time readers may even remember my elementary introduction to RTTY many years back, including the "One if a hamburger, Two for fries" signaling scheme to introduce the digital concept.

New Digital Communications Book

One of the items that I have wanted to see, and would even write if I had the time, is a basic introduction to digital communication. While I have reviewed several books on this subject, few were comprehensive enough to serve as a solid guide to digital circuits. Now, however, I have a new book in my hands that does appear to serve this function admirably.

The book is *Digital Communications With Radio Amateurs*. It really is not a book, but "books," which I will explain later. Although it is subtitled, "The Complete Packet Radio Book," it is a rather complete Introduction to conventional RTTY and AMTOR as well.

The first chapter introduces you to the history of digital communication, especially packet, with a tip of the hat to our Canadian neighbors who started the ball rolling in that fascinating mode. Digital mode operating privileges for a given license class, and basic equipment, are also covered.

The next chapter investigates the analog and digital worlds, using many diagrams, some like those in earlier RTTY Loop columns. Analog and digital data, as well as both serial and parallel transmission, are differentiated.

Other possibly troubling concepts are tackled here as well. The author clearly explains simplex, half- and full-duplex modes; data rate transmission in bauds and words per minute; and synchronous and asynchronous transmission schemes. This chapter concludes with some nuts-and-bolts information, including modem use and RS-232 connector wiring. This eighteen-page chapter is all meat, with no fat or other by-productsl

Amateur digital communication comes next, with the initial focus on Morse code. Surprised? Morse code is really the first digital mode in amateur radio! Baudot/Murray code, with familiar diagrams of old-fashioned transmitting distributors, complement the pages at this point, followed by descriptions of methods of transmitting RTTY, such as FSK and AFSK. Finally, the book examines ASCII and AMTOR codes, and gives a few simple circuit suggestions for interfacing computers and radios.

Next, the how and why of packet. You will learn every four-letter abbreviation known to the packet world, along with two letters, three letters, and who knows what else. It briefly describes protocols, emphasizing the AX.25 protocol commonly used in amateur circuits.

The TNC—Coming Attraction

Of course, in order to run packet, you will need a terminal node controller (TNC), and that is the topic of the next chapter. You can use your personal computer as a dedicated TNC, along with the more common stand-alone TNC. It examines the functions which take place within the TNC, and lists some of the basic types of machines out there to help you select just what you would like to use.

> ***"The author (in* Digital Communications With Radio Amateurs*) clearly explains simplex, half- and full-duplex modes; data rate transmission in bauds and words per minute; and synchronous and asynchronous transmission schemes."***

Once you choose a TNC, this chapter will hold your hand while you connect the device to your computer, and begin attempting to contact another station. It gives a bare-bones interface circuit. it is biased towards AEA equipment, but most commands are standardized, and the information should be of help no matter whose TNC you have.

Not all voice QSOs or packets are simple "Hello, Howdy Do" transmissions. The next chapter details the different operating modes, from keyboard through file transfer to bulletin boards, and explores the differences between VHF and HF packet.

One Network Better Than Two Packets

While two packet stations are nice, a network is better. Chapter Seven shows how the network concept progressed from the early RTTY days to the digipeater of the packet world. LANs, WANs, and GateWays; trunks, datagrams, and wormholes—they are all covered in a thorough, crystal-clear manner.

One chapter takes a detailed look at the question, "Why can't I use my computer to do all the work?" It gives programming ideas and offers solutions. Again, the AEA bias is present, but anyone can use the material.

Chapter Nine covers some "neat stuff" for packet. Whether a program is for the Macintosh computer or a high speed digital modem, this chapter presents some of the latest and greatest for the digital world. The book concludes with amateur satellite communication and tomorrow's technology.

My copy of *Digital Communications With Amateur Radio* is earmarked "Special AEA Edition," with a forward by Mike Lamb, and is available only from AEA or authorized dealers for $9.95. A slightly different version, written by Jim Grubbs, minus Mike's forward and with minor changes, is also available at your local Radio Shack store, catalog number 62-1332, for $6.95.

This book meets the need, which has existed so long, for a widely available introductory text on digital communications. It belongs on every amateur's, and club's, bookshelf.

With the New Year in, let me remind you that I have an index to back issues of RTTY Loop. I try to keep it as up to date as the column, and it is yours for an SASE and postage for two ounces (see above address). Feel free to bug me on CompuServe (ppn 75036,2501) and Delphi (username MARCWA3AJR) as well. I love hearing from you, and some of the questions I have received lately have sent me scurrying back to my texts!

More in store next month, featuring everything that you want to see, right here in RTTY Loop.

LETTERS

From the Hamsack

Military Net

I would like to get visibility for the amateur radio operators who are on active duty in the US military so we could institute phone patches within the US or overseas areas where authorized. It would also serve to give recently transferred hams a point of contact in their new area. If you're on active duty and would like to be listed, regardless of branch, please write to:

Robert T. Godlewski
HMC 593rd ASG, Box 66
Ft. Lewis WA 98433-5410.

New Ham

This letter is from a person who, until a few weeks ago, was completely ignorant about amateur radio. Now, thanks to your magazine and the book *Amateur Radio, Super Hobby*, by Vince Luciani K2VJ, I am a little smarter.

Though you must write for everyone from beginner to expert, I have enjoyed reading *73*. I even found myself enjoying some of the technical articles I didn't understand!

Mike Sanderson
Janesville CA

RDFing in Chicagoland

RDF has demanded much of my effort for the last 12 of 25 years as a ham. In Chicagoland, there are unsponsored hunts every first and fourth Saturday, attended by a core of dedicated hunters. The second Saturday of each month, the Arlington Communications League sponsors a hunt, and the third Saturday, the Chicago FM Club sponsors a hunt. Once or twice a year on a fifth Saturday, the Greater Chicagoland Foxhunt is run. It pits teams of hunters, usually representing clubs, against one another to find two foxes and win the Trophy. They keep this prize until the next hunt. The Lake County Amateur Radio club of Indiana has been a regular participant, along with the Chicago FM Club.

We would like to involve other organizations in this. RDF does not require an expensive outlay of exotic equipment. Also, it is not a slow and methodical activity, but perhaps the most physical and fastest paced activity in amateur radio.

I have participated in DX contests, sweepstakes, Field Day, public service events, and packet, but for sheer excitement, I find foxhunting to be my favorite. I would like to see a calendar of regularly scheduled hunts published so local and regional contacts can be made. I intend to contact other groups in the country to get information on their hunts and, if possible participate. This will be on a local level, but could conceivably cover a larger area. Vacations would be ideal for hams to take along some of their gear and participate on a hunt in another part of the country—but first, we need to know where and when the hunts are being held. We have to start this before we can have a National Championship.

Mike Brost WA9FTS
Norridge IL 60656

Legalities, Legalities

This refers to the news item about Net-Rom vs Nord Link (Sept. '88 QRX). It is highly likely that in some countries Nord-Link could be charged with violating a copyright. Different countries have different copyright laws, but... Net-Rom is copyrighted under US law.

They say that it is a valid copyright. However, everything connected with packet radio was invented in recent years. So most of the information in their copyright was available from previously copyrighted documents, such as the technical manuals issued with different pieces of equipment. Does Net-Com have releases from all the previously copyrighted material owners giving them the rights to use their copyrights? And where there may be conflicts in the previous copyrights, does Net-Com also have releases from the conflicting copyright owners?

It is impossible to have a copyright in this field that has not used previously copyright items. The words "Packet Radio" were previously used in copyrighted documents. Parts of any circuit must have been previously copyrighted documents. Does anyone have a listing on all this, and releases from all the people involved?

If Nord-Link used this question of whether the Net-Rom copyright is free of any copyright infringement itself, then the courts would probably throw it out.

Paul J. Franzel
New City NY 10956

Tasty 73s

I am a Novice, stationed in Iceland with my family, in the Navy. My mother heard me passing 73s over the air and asked me what "73s" were. When I told her, she said she'd been passing 73s for years, with a product both nutritious and delicious. This ice cream is named "73s" because it contains seven ingredients in proportions of three's, as follows:

3 bananas
3 cups milk
3 lemons, juiced
3 cups heavy cream or
3 pints half and half in place of milk and cream
3 oranges, juiced
3 cups sugar

Mash bananas in blender, add juice of lemons and oranges. Add remaining ingredients and stir well. Freeze. For variety, use other fruits instead of bananas. Serves 8–10 regular people or five amateurs on the air.

Bill Smallwood KB2EHK/TF
Keflavik, Iceland

More Mobile

You asked about my opinion of your magazine. Well, it's the *best* in its field by far. Next, you asked about what I would like to see in your mag. Your coverage of ham radio is far better than the rest, but I would like very much to see articles about mobile operation, mobile antennas, and antennas that are portable and/or can be used in apartments.

I live in California where everyone thinks we have hundred-foot towers and 1500 watts of power on all bands, when in fact we have so many restrictions we're lucky we can operate radio at all. Most people have to live in apartments, condos, or mobile home parks where antennas are not allowed.

I'm sure that you and your staff could cover these topics completely in future magazines. It will probably help your sales, also, which should be tops.

Jerry Delettera N5KKR
California

Thanks very much for your rave comments! Be on the lookout in the April '89 issue for reviews of several mobile and compact base-station antennas for VHF and HF. Also, there are plenty of these reviews in '87 and '88. Refer to the December issues of 73 for the Annual Index of articles and reviews. Failing that, give us a call and we'll look these up for you...

de NS1B

Story of 10-10

Sometime in the 50s, a group of hams got together and started 10-10 International. They required 10 contacts with 10 members as a prerequisite to join the organization. From that point, an individual could upgrade to different awards as he contacted more members. Each contact had to be made on 10 meters. This quickly branched out to local chapters in communities throughout the US and then the world. We are the City of Roses Chapter. To keep activity high, each chapter has awards for contacts with other members on 10 meters.

10-10 International holds a net each week, originating in California, with the intent of upgrading its members and collecting new 10-10 members. Each active local chapter also holds a weekly net for the same purpose. You will find that on any given day, there is a 10-10 net going on somewhere in the country and also throughout the world. Some members have made more than 10,000 10-10 contacts on 10 meters.

With the advent of Novice Enhancement, which for the first time has given voice privileges to Novices on an HF band, we have added a net in the Novice band so that the Novices may join an active group of hams and also join 10-10. 10-10 International and other chapters have done this also. Novices are eligible for any of the awards; there are no restrictions other than the band limitations of their license. All contacts must be made on 10 meters, individually or on nets.

10-10 International has over 50,000 members, and it's growing daily. This camaraderie is probably the single greatest force in preserving this valuable 1.7 MHz bandwidth of the HF spectrum.

Bob McElhatton KF7AK
City of Roses Chapter Head
Boring OR 97009

A Simple LED Checker

Get the bad LED out

by Tom Thompson

Have you ever been in a hurry and needed to test an LED for proper operation or polarity? You look for your DVM, and when you find it, you're not quite sure about what to do with it? If you've experienced this, I have something better, faster, and easier to use, and costs less than $5.

Theory

The theory for testing LEDs is quite simple. Apply the proper voltage, limit the current, insure proper polarity, and the LED comes on! The circuit in Figure 1 does this with a minimum of components. When you press S1, the battery supplies the test current to the LED. R1 is a 680Ω resistor that limits the current to just a little over 10 mA with a new battery. This allows good test current throughout the life of the battery.

Construction

The reprint of the label is the actual size. You can use it to determine the proper spacing of the mounting holes for both the switch and the socket. Use an X-acto knife to remove the area inside the two squares where the socket and switch are mounted. Place the label on the plastic box cover and mark the centers of the two cut-out areas. Once this is done, you can remove the label and drill the two holes. S1 is ¼" and the socket is 5/16" in diameter.

Any transistor socket will work. If you substitute, choose the pins you want to use and drill the mounting hole to the appropriate size.

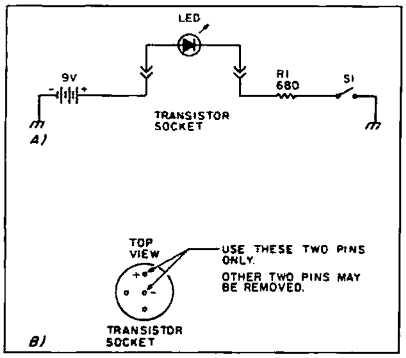


Figure 1. a) The LED Checker schematic. b) Top view of the transistor socket.

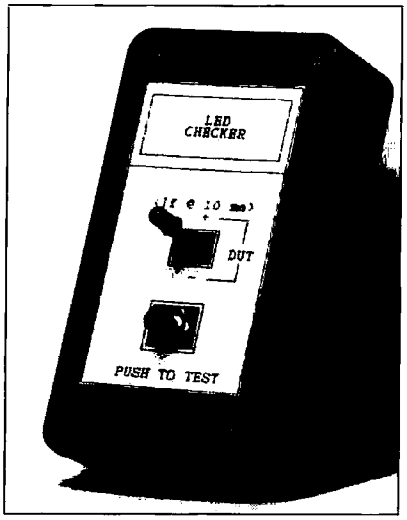


Photo A. The LED checker.

The switch is held in place by the mounting hardware that comes with it. The socket is pressure-fit and held in place with a good cement, such as super glue.

Solder the black (−) wire of the battery connector to one side of S1, and solder the red (+) wire to one of the solder contacts on the test socket. Next, solder the 680Ω resistor between the unused connector on the test socket and S1. (Refer to Figure 1.)

A battery compartment spacer is constructed by cutting two pieces of cardboard ⅞" x 2¼" and gluing or taping them together. A small piece is cut off the bottom to allow access to the battery wires (Figure 2).

Cut the label to the correct size and cover the back with rubber cement. This will attach your label securely to the plastic case. Be sure to line up the cut-outs in the label with the socket and S1.

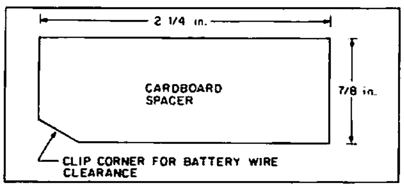


Figure 2. Cardboard spacer. Clip corner for battery wire clearance.

Testing

Insert the LED into the socket and press S1. If the LED does not come on the first time, remove it from the test socket, swap the leads, and reinsert it into the test socket. Press S1 again and the LED will come on. If it doesn't, it's defective. To check your tester after construction, it's a good idea to use an LED you believe is good.

There you have it—a useful item to have in the shack, and a real quickie to put together. Have fun!

Parts List

Part	Part #, Description
9 Volt battery clip	RS270-325
9 Volt battery	Standard 9 volt
Switch S1 SPST MOM.	RS 275-1547
Transistor socket	Jim-pak TO-5 Socket, RS 276-548
Plastic case	RS270-221
Resistor R1 680Ω	RS271-021 ½watt
Cardboard spacer (⅞" x 2¼")	See Figure 2

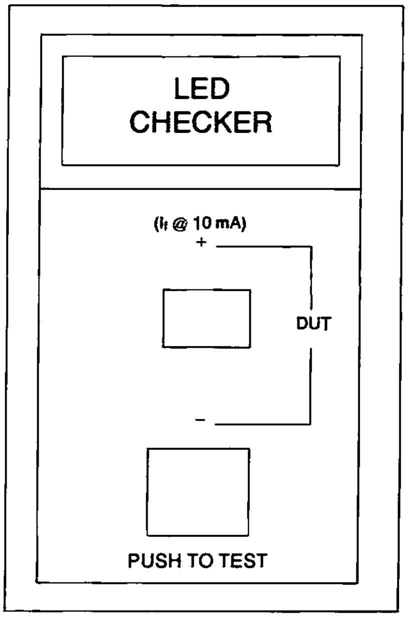


Figure 3. LED Checker label, to cut out.

Number 19 on your Feedback card

NEW PRODUCTS

Compiled by Linda Reneau

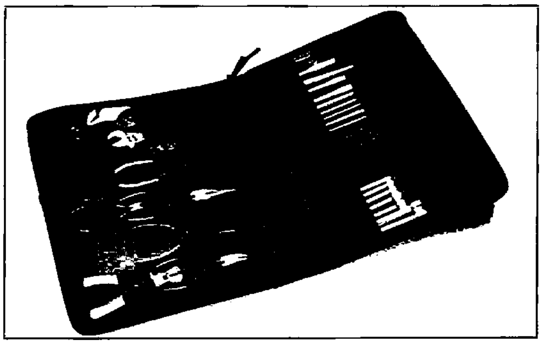
PRODUCT OF THE MONTH

Aries-1™ Software

Ashton ITC announces *Aries-1*™ database software. *Aries-1* unites multi-mode Terminal Units and transceivers with computer interfacing capabilities. It also has a real-time logging function. It lets you display the Logbook and Transceiver status simultaneously, and remains resident in memory while other programs run. In addition, *Aries-1* features a Contest Mode; uploading and downloading files through packet and RTTY; CW speed control; and searching and printing of log data by band, mode, country, and other fields you set up.

Transceivers currently supported are Kenwood models TS-940S, 440S, 140S, 640S, 711A, and 811A (with appropriate Kenwood IC-10 Kit and IF-232C interface) and ICOM models IC-735, 761, 275, 375, 475, and 575 (with the ICOM CT-17 interface). Terminal units currently supported include the AEA PK-232, Heathkit HK-232, and Kantronics KAM all-mode units.

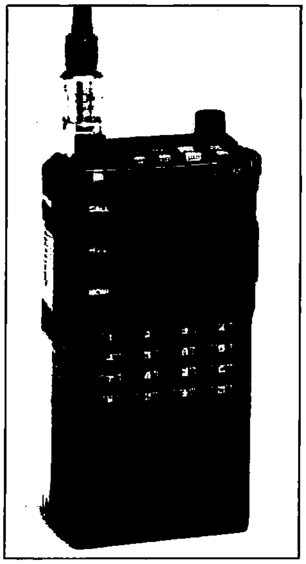
Aries-1 includes sample message files, a demo-log, and a User's Guide. It is available on 5¼" or 3½" disks, and runs on the IBM and compatibles with at least 256K of memory. Price, $39.95 plus shipping and handling. For further details, contact *Ashton ITC, PO Box 1067, Vestal NY 13851. 607-748-9028.* Circle Reader Service number 201.



COOPERTOOLS™

CooperTools™ offers a new TCS200 soft-sided tool case made of Cordura® leather-like material, designed for the Xcelite® line of tool kits. The kit is available with 10 tools, which include five pliers, a wrench, an electronic snip, a wire stripper-cutter, an electrician's knife, and a curved-nose seizer. In addition, it contains 27 interchangeable screwdriver/nutdriver blades (a selection of slotted, Phillips, and hex) that fit into straight or Tee handles. Price of the tool kit is $447 with tools and $150 without tools. Contact *Xcelite Soft Kit, CooperTools, Box 728, Apex NC 27502.* Circle Reader Service number 203.

ICOM AMERICA, INC.



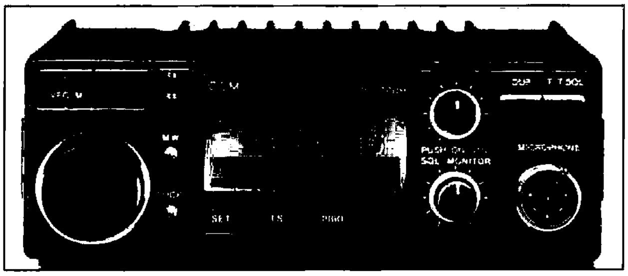
The IC-12GAT hand-held transceiver from ICOM has wideband coverage from 1240–1300 MHz, 1 W power output, 20 memory channels, programmable scan and memory scan, repeater monitor, and built-in 1750 Hz repeater access tone. It is also splash-resistant for outdoor conditions.

The new "G" series is compatible with all ICOM IC-2AT/IC-02AT battery packs, headsets, and speaker mikes. Optional UT-40 beeper. List price, $529.

Also from ICOM is the IC-228A 2-meter 25 W mobile rig (the 45 W version is the IC-228H). It features wideband receive 138–174 MHz and transmit 140–150 MHz; multi-color LCD; 20 memory channels with programmable and memory scan capability; priority watch while operating on another frequency; and an optional UT-40 tone squelch unit which acts like a beeper/pager.

This compact unit measures 5.5" W x 2" H x 5.4" D (the IC-228H is 6.2" D). There are 13 front panel controls for easy operation.

Suggested retail prices are $509 for the 25 W IC-228A, and $539 for the IC-228H 45 W version. *ICOM America, Inc., Corporate Headquarters, 2380 116th Ave. N.E., PO Box C-90029, Bellevue WA 98009-9029. 206-454-8155. Telex: 152210. FAX: 206-454-1509.* Circle Reader Service number 202.

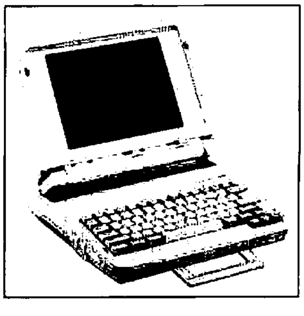


HEATH COMPANY

Heath is offering the first kit laptop computer, the HS-2860. It is fully PC and AT compatible. It has a 12 MHz 80286 processor, 1 MB of standard RAM (expandable to 3 MB), and a 1.4 MB 3.5" disk drive (second internal drive, 20 and 40 MB internal hard disks, optional). It can handle spreadsheets, databases, word processing, and a variety of graphics.

Standard features include: 640 x 400 pixel resolution; supertwist LCD screen; removable battery pack providing up to six hours of continuous operation; Expanded Memory Specification (EMS); parallel port; serial port; RGB video port; and an external floppy drive jack. The HS-2860 is 3.07"H x 12.2"W x 15.4"D.

You may order the HS-2860 by calling *1-800-253-0570.* The kit sells for $2,999. The HS-2860 is also available as part of a portable computer workstation with a Brother 9-pin printer, nine-foot parallel cable, and software package. These items are features in the 1988 Heathkit Christmas catalog, which you may order by calling *1-800-44-HEATH*, or by writing *Heath Company, Department 350-038, Benton Harbor MI 49022.* Circle Reader Service number 204.



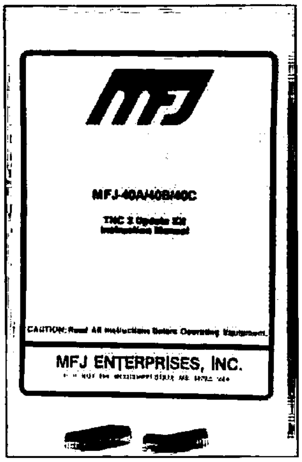
MFJ ENTERPRISES, INC.

MFJ Enterprises, Inc., has three new software upgrades to give previous MFJ Packet units the features of their latest MFJ TNC units. These upgrades are:

MFJ-40A: Firmware release 1.1.5. Supports basic Packet features for TNCs with 16K RAM. Price, $19.95.

MFJ-40B: Firmware release 1.2.6. 32K with 32K RAM upgrade. Price, $39.95. This release also includes KISS, MFJ EasyMail™, and WEFAX receiving capability for the IBM, compatible, or Macintosh computers, using an MFJ Starter Pack option for $19.95.

MFJ-40C: This is the same as the MFJ-40B without the RAM for TNCs that already have 32K RAM. Price, $19.95.



MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762. 800-647-1800 or 601-323-5869. Circle Reader Service number 205.

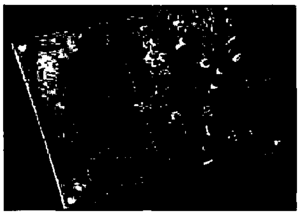
GTI ELECTRONICS and SOFTWORKS, INC.

WeatherTrac™ is a combined hardware/software weather satellite imagery system jointly developed by Softworks, Inc., and GTI Electronics. It combines a 64-level gray scale with a 256,000+ color palette at 640 x 480 resolution (scrollable to 800 lines). WeatherTrac also supports 1024 x 768 mode with a 16-level gray scale and the same palette; plus image "looping," 3-D projection, histogram analysis, and AVHRR radiance calibration for direct read-out of scene equivalent temperatures. VGA+ image analysis tools use a standard mouse interface. Among others, the system captures analog weather satellite imagery from GOES-WEFAX, NOAA/TIROS-N APT (single or dual channel), SOVIET METEOR, METEOSAT, GOES-TAP, and NAFAX (high frequency FM).

The basic WeatherTrac Audio Decoding System includes an external audio interface, an internal acquisition and control card, enhanced VGA+ graphics card, software, and manual, for $3495. The EGA version, without the mouse-driven image analysis tools, and excluding an EGA graphics board, is $1895.

Required are an IBM PC/XT/AT or compatible, a matching graphics monitor, and an appropriate audio front-end (antenna/receiver) for the mode(s) of interest.

Contact *Softworks, Inc., POB 3114, Allentown, PA 18106. 215-395-4441.* Circle Reader Service number 208.

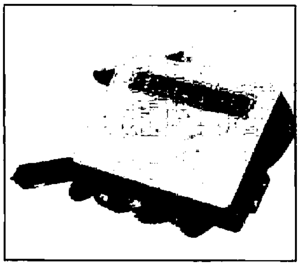


MICRO COMPUTER CONCEPTS

Micro Computer Concepts' RC-1000 Repeater Controller is available from R&L Electronics, complete with manual, schematics, and assembly drawings, for $219.

The RC-1000 is a microprocessor-based (Intel 8751) repeater controller with an autopatch, pulse or DTMF dialing, reverse patch, and control lines for remote base. Contained on a 5.1" x 3.6" PCB are the Mitel 8870 DTMF decoder, audio switching with DTMF muting, six pots for audio adjustments to and from the receiver, transmitter, and phone line.

A relay driver is included for active low PTT and transistor buffered selectable active high or low COS input, 10 jumpers for selecting controller options, and a remote base (interface optional). The RC-1000 has 32 control codes and 10 user codes, all accessible via the repeater receiver or phone line. The on-board rectifier/regulator allows powering of the controller via 12 AC or DC requiring only 200 mA. Wired and tested, the RC-1000 is distributed through *R&L Electronics, 1315 Maple Ave., Hamilton OH 45011. 800-221-7735 or 513-868-6399 in Ohio.* Circle Reader Service number 206.

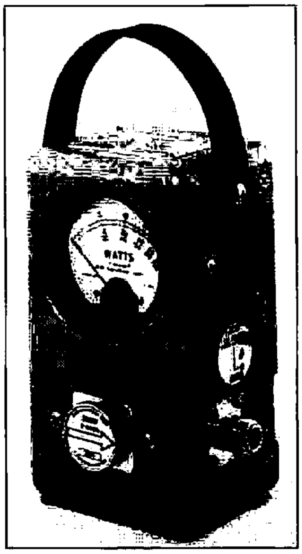


ATLANTIC SOLAR PRODUCTS, INC.

The Pocket Power Inverter, a 12 V DC to 115 V AC power supply from Atlantic Solar Products, measures 1.2" x 3.5" x 4.5", and weighs 14 oz. Plug it into a cigarette lighter and you have an AC power supply to operate sound and video equipment, electronic test equipment, small appliances, and communications equipment, such as FAX and answering machines. You can also use it to recharge batteries.

It features an automatic shutdown to prevent overloading and excessive discharge, audible low-battery voltage alarm, 90% extended use of the DC source. The Pocket Power Inverter's operating range is 10–15 V DC with a voltage out of 115 AC 200 Watt surge capability. Price, $149.95.

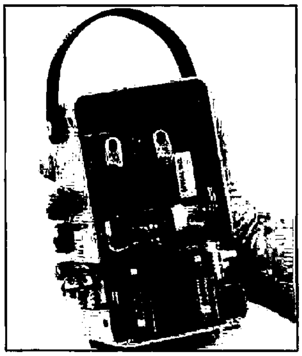
Atlantic Solar Products, Inc., 9351-J Philadelphia Road, Baltimore MD 21237. Circle Reader Service number 207.



BIRD ELECTRONIC CORPORATION

The new Bird Model 43P Wattmeter measures true peak power of SSB and AM modulated RF, as well as certain rectangular limited pulse signals. The Model 43P operates exactly the same as the Model 43, but includes peak reading circuitry to provide a second operating mode which lets you measure peak power to an 8% F.S. accuracy without affecting the CW measurement capabilities. This circuitry is powered by two 9 V NEDA 1604 batteries with an anticipated life of forty-eight hours in peak mode.

You need no special elements for peak measurements. The 43P uses the full array of the standard Bird plug-in elements. Depending on the element you select, your overall frequency range is 450 kHz to 2.3 GHz, and your RF power range is 100 mW to 10,000 W. The new Bird Model 43P is $279.



For owners of the standard Model 43, Bird offers a Retrofit Kit, Model 4300-400, for $90. The kit includes a PC board which mounts inside the Model 43 housing. Conversion time is less than fifteen minutes. This enables your Model 43 to make the same peak power measurements the Model 43P can make. It also uses the same batteries and meets the same F.S. accuracy.

For more information on the new Bird Model 43P Wattmeter or the Model 4300-400 Retrofit Kit, contact your Bird distributor or *Bird Electronic Corporation, 30303 Aurora Road, Solon OH 44139-2794. 216-248-1200. FAX 216-248-5426.* Circle Reader Service number 209.

Number 27 on your Feedback card

QRP

Low Power Operation

Mike Bryce WB8VGE
2225 Mayflower N.W.
Massillon, OH 44646

The Captive Electrolyte Battery

Using the proper method, you'd be surprised at the amount of power you can save up in a couple of sunny days. A relatively new innovation in lead-acid battery construction uses a captive electrolyte. The Gel/Cell™ from Globe Battery and the Absolyte™ absorbed-electrolyte battery from GNB Battery Company work about the same as the liquid lead-acid battery, only the electrolyte is jelled. The batteries are then fully enclosed, allowing operation in any position. They will not leak, spill, or emit gas. Of course, some gassing occurs, but special chemicals inside the battery recombine the gas back into the electrolyte. If excessive gas is generated, a special one-way vent allows the gas to escape.

In these gell-cell batteries, you can't add water or take specific gravity readings. They stand up to freezing temperatures without harm. The captive electrolyte concept provides a solution to many of the basic problems inherent in lead-acid batteries, and although these batteries are more expensive per unit of capacity than their liquid-filled counterparts, their advantages often outweigh the cost differential. You should consider them for all photovoltaic applications, especially those in which site access for regular periodic maintenance is impractical.

Batteries for Photovoltaic Energy Storage

Armed with this information, how do you go about choosing the proper battery for PV storage? First, I don't recommend using used batteries, unless you know where they came from and what they where used for. The best method is to use batteries of the same make, type, manufacturer, and age. When the batteries age together, the whole bank will age at the same rate, unless you get a bum battery in your purchase.

One of the strong indications of a battery that it is deep-cycle is its heavy weight. Don't be fooled, however, into buying a large truck battery or Cat™ battery just because it is heavy. All you really get is a heavy starter battery. Truck batteries are not deep-cycle; neither are most Die-Hards™. Since advertising is always a bit less than accurate, be persistent, skeptical, and slow-moving. Because of the weight, purchase your batteries from a local source, unless you can get together with a group and purchase in large lots.

Who makes the best deep-cycle battery? A loaded question, but some of the better manufacturers are: Exide, Trojan, Douglas, and GNB. I use the Exide EV-IV and Exide GC-4. These are designed for electric golf carts. Each battery weighs about sixty-five pounds. The nominal voltage is 6 volts, so you need two batteries for a 12 volt system. The Exide EV-IV and GC-4 are both rated at 220 amp/hr at a 20-hour rate. That means I can draw 11 amps for over 20 hours on each string of two batteries. My system has eight of these batteries, so I can pull about 44 amps from the bank for 20 hours!

Installing and Mounting the Batteries

In a recent test, I loaded the entire storage bank down at 5 amps, and five days later the load was still going. The condition of the battery bank was at a 65% depth of discharge. Since it takes two of the Exide EV-IVs to get a nominal 12 volt system, sixty-five pounds per battery can add up quickly. I have roughly one quarter ton of lead and acid in the basement, not counting the extra six portable 105 amp/hr jobs. Mounting the batteries clearly can become an engineering task!

In my original setup, I used two-by-fours bolted to the cement floor. Over these I placed ¾" external plywood. Then I installed wood runners on the plywood, and onto these I set the batteries. Besides keeping the bottoms of the batteries from sitting right on top of the plywood, the runners provided a path for air exchange between the individual batteries. Lastly, I gave everything several coats of polysealer.

Keep in mind you need two batteries to make up a 12 volt system. You can connect them together with battery connectors like those in your car. I soldered the connection and then used the built-in clamp, making sure not to tighten the bolts too much. The connectors are made of lead, and the bolts can pull through. I used a "flex" size double-"O" multistrand copper wire for the interconnecting cable. If you can't find such a critter, ask for welder cable at your local welding supply house. You won't need too much for interconnections, so ask for the loose odds and ends.

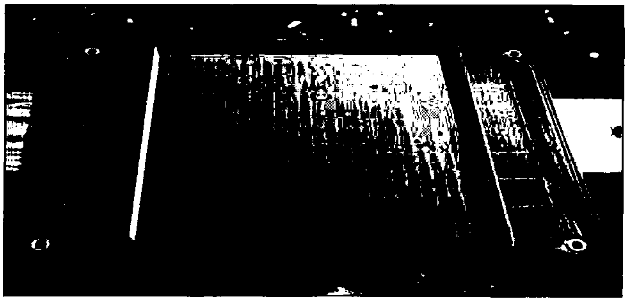


Photo A. These small 5-watt panels operate quite a bit of gear when hitched to a good storage system.

In designing your storage bank, remember that voltage is additive when batteries are connected in series. Ampere-hour (capacity) is additive when batteries are connected in parallel. You can use almost any type of configuration provided you follow the above requirements concerning battery age, make, etc. You can add more parallel batteries when your pocket book permits. While this may contradict my advice to use batteries of the same age, you can add batteries later as long as you provide enough charge current to the battery bank. The new cells and the old cells will then equalize the charge. It's not a GOOD idea, but you can do it. If you use a lot of energy from your battery system, and your PV array is undersized for maintaining energy storage, it would then be best to replace all the batteries. Otherwise, go ahead and mix the new with the old.

Measuring Battery Charge

No one has yet invented a "fuel" gauge for batteries, and it is not easy or cheap to determine how much "juice" is in your batteries at any instant. All you can do is measure the amp/hr out of the battery system and the amp/hr into the system. But this is expensive and not worth it. There are two other ways of ball-park guessing the battery state-of-charge: measuring specific gravity or terminal voltage.

Measuring Specific Gravity and Terminal Voltage

Let's look at specific gravity first. As you know, a discharging battery will show a drop in the specific gravity when measured with a hydrometer. This reflects the state-of-charge only within these guidelines: The battery electrolyte must be at 80°F, and the battery must have been discharged at the proper amp/hr rate.

A higher than normal discharge rate gives false readings, as does too-high or too-low electrolyte temperatures. At very high rates of discharge, the electrolytes on the plates are weaker than those in the rest of the cell (because they can't mix with the rest of the electrolytes), giving a false and misleading result.

As lead-acid batteries discharge, the drop in specific gravity is quite linear. A plot of the results shows a nice curve. When charging the batteries, however, the specific gravity doesn't return the same linear reading. You have to charge, and charge, and charge some more before the hydrometer starts to show an increase in specific gravity.

Measuring battery terminal voltage is by far the most common method of checking the state-of-charge. The actual battery voltage within each cell of a battery bank varies, depending on whether it is being charged or discharged, and whether it is standing open-circuit (unconnected) or not.

For single cells, the voltage generally ranges from 1.75 to 2.5 volts, with 2.1 volts nominal. So a fully charged six-cell lead-acid battery terminal voltage is 12.6 volts—not 13.8! We can and do float the terminal voltage at 13.0 to 14.5 volts, but the actual battery voltage, after the surface charge is removed, settles down to 12.6 volts. Keep this in mind when running RF gear. Almost all commercial RF transmitters spec their amplifiers at 13.8 volts. Running the same radio from your battery bank will produce a lower RF output. You can really see that one

volt drop, especially in high-power RF equipment. All the same conditions that affect the results in hydrometer readings also raise their ugly heads in terminal voltage measurements, especially a very high charge current.

There's a lot going on with batteries, but I'm not quite done yet! Just as we have learned that batteries come in different voltages and capacities, they also come in different percentages of acid. We have 1300, 1280, and 1265 batteries. If your local friendly battery person asks you which kind you want, tell him 1280. What do these numbers tell? They indicate the full charge specific gravity acid concentration.

A fully charged 1300 battery reads 1.300 on the hydrometer. Likewise, a fully charged 1280 shows 1.280 on the hydrometer. Golf cart batteries and your Exide HC-27-106 battery are 1280 batteries. All the very large batteries built for heavy industrial use are 1300 batteries, as are the batteries for electric personal carriers, tow motors, and floor sweepers. The batteries your local phone company uses are 1265, which have a life of over 25 years. The lower concentration of electrolytic acid will not eat away at the insides as fast as a higher one would.

Last Word on Battery Testing

How do you test a battery to find out if it is up to par? Charge it up and then discharge it at the recommended rate. Next, plot the results to find out if the battery can deliver its rated capacity. This is not practical for most of us, especially in measuring a large battery bank. At many larger battery shops, they use a load meter to check each battery they sell. It's simple to use. You load the battery down at three times the total amp/hr rating of the battery for 15 seconds. A good battery will hold its terminal voltage to at least 9.6 volts. For example, to test one 6 volt Exide battery, load the battery at 660 amperes for 15 seconds. The battery must hold its terminal voltage at 4.8 volts (half the required 12 volt rating) to pass..

Working with your own energy production is a fulfilling pastime. Checking battery fluids, cleaning and checking cables, and removing accumulated dust and debris becomes routine.

Taking Precautions

When working around batteries, you must be aware of the danger, as deadly as it is silent, of voltage. While most of us use a nominal system voltage of 12 volts, some of you may use higher battery systems of up to 140 volts DC. It's easy to become careless, especially if your system is 12 volts, and I know of no one who has been zapped with 12 volts. But imagine—you're wearing a ring, get it across two terminals, and 1000 amps of current flow through it. Instant meltdown! You lose a finger!

Gas is another major danger. Because of gassing, you must provide adequate ventilation for the storage room. Besides the unpleasantness of the "dry throat" you get from the presence of free hydrogen, there's always the excitement of the Hindenburg effect: it only takes 4% hydrogen and one match to demonstrate it. If you don't have tight connections at the battery terminals, or if you drop a wrench between the posts, you don't even need the match! Even if only one battery, instead of the whole bank, explodes, you've still got a good chance of getting a cardiac arrest from the shotgun noise at close quarters, or some nasty burns from sprayed acid.

Carelessness and batteries don't mix—not quietly, that is. For goodness' sakes, use an eye shield—battery acid is the third major danger.

Let's See Those Pix!

I still have not received any photographs of QRPer shacks. Looks like I'll have to be the first and use one of my shacks. That means I'll have to clean it up first! I'll be reprinting the HW-8 handbook. I'm still looking for mods for the HW-8 and the newer HW-9, and I hope to have the books done by the spring of '89.

Next month I'll have a lot of odd and ends to distract you from the cold. Miss one month and you'll miss a lot. Slow that electric meter down, go QRP!

Number 28 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free, on a space-available basis. To make our job easier and to insure your listing is correct, please type or print your request clearly on a full (8½" x 11") sheet of paper. Double-space and use upper and lower case letters where appropriate. Also, write numbers carefully—a 1, for example, can be read as an l or an i or a 7 as a 1. Thanks for your cooperation.

Need schematic, etc., for Delco 30BCTS1 from Sam's AR-339. Will pay postage and copying costs.

Lisle T. Hines K2QLA
11 Meadow Drive
Homer NY 13077

Wanted: Manual and schematic for KLM Linear Amplifier, Model No. 30-140B. Will gladly pay copying and mailing costs.

Edward Moiser N8IOV
4376 Coolidge Road
Coleman MI 48618

I am looking for the following items (please state price and/or condition in correspondence): Two MRF-455 A transistors; MFJ-962, -949C, -941D, or 989 antenna tuner; five 7868 tubes; ten #12 6-V lamps for Bogen PA Amps; one bandswitch each for the Panasonic RF 2800 receiver #RSR 98W or equivalent; one printer and disk drive for the Tandy Color Computer II Model 26-3127; and one Z-80/CPM and Modem Board for the Apple IIe Pro System.

Mike Adams
Haney Vo-Tech Center
3016 Hwy 77
Panama City FL 32405

I'm looking for manuals and/or schematics for a Heathkit model GR-91 receiver. I'll gladly pay for any costs incurred.

Darrel L. Daley KL7DN
Radio Free Vermont
P.O. Box 445
Putney VT 05346

Does anyone know where I might purchase a new or used TK-1/BC-1 memory backup power supply for my Kenwood TR-7800? It is a small AC adapter that plugs into a wall outlet and retains the memory frequencies in the TR-7800. Thank you.

Michael A. Horn
516 Union Place
Fremont OH 43420

I would like to hear from anyone who uses the Tandy Model 100 and 200 for amateur radio. I am interested in any programs, especially satellite tracking.

Scott Harvey KA7FVV
2517 N. Calispel
Spokane WA 99205

Gentlemen: I just "inherited" an *old* Gonset Communicator II, 2 meter AM transceiver! Someone removed the mike jack and didn't sketch the location of the wires. I need a schematic for this unit. If you have one, I'd be glad to pay for copying and mailing costs. Thanks for helping me get this old rig back on the air!

Bert Voth WA0PWE
802 Forest Drive
Olathe KS 66061

Wanted: Machine language program for the TRS-80, model 1, level 1 or 2 (prefer level 1) to TX/RX RTTY via expansion port. Will pay nominal fee.

Frank Brinson
5113 Richland Ave.
Chillicothe IL 61523

I need a schematic for Swan 350B and schematic/manual for Swan HF 700S transceiver. Will pay for any charges. Thanks.

Charlie Wallace
Rt. 3, Box 223K
Big Pine Key FL 33043

I need a service manual or at least a schematic for an Edgecom System 3000A VHF FM 2 meter transceiver. I will pay for copying or other costs.

Chuck Crowley K5BER
215 Clower Ave.
Long Beach, MS 39560

I need a diagram and part values for my ailing Hickock Teaching Aids Scope, Model OSK-4, and will be glad to reimburse someone for copying costs and postage.

Paul Hinkamp W8YOU
1304 Ashly Ct.
Midland, MI 48640

Number 25 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell PE KØOV
PO Box 2508
Fullerton, CA 92633

Quads And Yagis: The Winners' Choices

Here in Southern California, all but one of our monthly hunts are on the 146 or 220 MHz bands, and almost all competitors use a small beam, either a quad or a yagi, as the primary radio direction finding (RDF) antenna. The mast either goes through the window and is fastened to the door handle with some sort of bearing lash-up, or there's a hole in the roof with a thrust bearing and a compass rose at the bottom of the mast.

Why would anyone choose such an unwieldy RDF setup? After all, it's large and cumbersome compared to loops, L-Pers, SuperDFs, Dopplers, and other available schemes. The answer, as we'll see, is that it's a simple but very effective solution to a number of RDF problems.

Beam hunting is so simple that you may already have everything you need to get started: a quad or yagi antenna, a receiver with an S-meter, and an attenuator to knock down strong signals. (More on attenuators in a future column.)

Intuitively, you've probably guessed that the way to hunt with this setup is to swing the beam around until the hider's signal peaks on the meter. Then drive in the direction that the beam points. It's almost that simple, which is one reason why beam hunting is so popular. The S-meter will bounce around with the usual mobile flutter as you whiz down the road, but with a little practice you'll find it easy to take bearings on the fly, using "eyeball integration" of the meter reading.

The hilly terrain and large boundaries of southern California hunts make a high gain antenna system a necessity. Starting points are on hilltops, and as often as not the hider is dozens of miles away running a couple of watts from a canyon or river bed. It's important to keep hearing the signal after coming off the hilltop, if it's at all possible. There is nothing more frustrating than having to continue to go in the direction from which the signal was last heard, hoping to catch some signal again soon. After all, the idea is to hunt down the signal, not to hunt for the signal.

A 4-element optimum-spaced quad has a gain of around 10 dB. Other popular RDF antenna systems for the 100 to 500 MHz range have no gain, and may even be quite lossy. You can make the sensitivity of your beam hunting setup even greater by adding a low-noise preamp in the antenna line.

Beams Shine in Multipath

Last month I pointed out that VHF RDF is much more difficult when the signal is bounced around by nearby and distant features of the terrain. The signal may arrive at the hunter's location from more than one direction, via more than one path. Sorting out the direct and reflected bearings takes good equipment and lots of practice.

In a severe multipath situation, a sharp beam provides more information than a Doppler or other RDF system. As you rotate your beam around a full 360 degree turn, each of the apparent signal sources gives a peak on the S-meter. You can mark all these directions on your map for comparison with previous and future bearings along the way. (You do have good maps, don't you?)

Your S-meter will tell which of the signal sources is strongest. Usually that's the direct signal, and smaller peaks are reflections, but there are enough exceptions to that rule to make for some really tough hunts.

Photo A. A yagi—an excellent starter antenna for RDFing.

Select Your Polarization

If you've experimented with OSCAR satellites, you know how important it is for transmitting and receiving antennas to have the same polarization. It's every bit as important in T-hunting. On most hunts, the hider is free to select any polarization, so hunters must be prepared.

Incorrect polarization of your RDF antenna not only diminishes the level of the direct signal, it also increases the relative level of unwanted multipath. That's because when the signal bounces, the polarization often shifts. If the fox is horizontally polarized and your RDF antenna is vertical, you'll lose 10 to 20 dB system gain for directly received signals. You'll have less loss than that for reflections, because some scattered back signal components will be near vertical. The net effect is to accentuate the reflections.

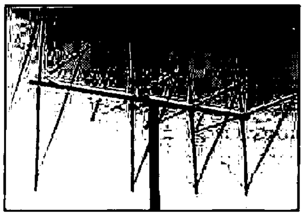


Photo B. The wire-quad antenna.

The ability to select polarization is an important reason why beams are the most popular VHF RDF antenna. The antennas in the photos are oriented for vertical polarization, but are designed so that they can be readily changed to horizontal (or angles in between). Smart hunters always check polarization at the beginning of the hunt, then check again later on in a clear signal area while closing in. Many other RDF systems, including Dopplers, have only vertically polarized antenna elements.

Quad or Yagi?

What kind of beam is best for two meter RDF? Is a quad better than a yagi? Many hams think so, though each type is commonly used. A quad is half as tall as a same-band vertically polarized yagi. This can either give lower profile on the vehicle, or allow a higher center of radiation for the same maximum height—take your choice.

Proximity to the vehicle roof affects performance of a quad less than a yagi. Best of all, a quad has about two dB more gain than a yagi for the same boom length. Clearly, the performance of a lightweight quad makes it worth the effort to build it.

Quad elements don't have to be diamond-shaped like the ones in Photo B. You can make the sides parallel and perpendicular to the car top (box configuration) for a lower profile, if you feed the driven element properly for the desired polarization. You could also make the elements triangular (delta quad) or even circular. Local hunters have used all of these types successfully. The circumferences of the elements remain the same fractional wavelengths, no matter what the shape.

While some other RDF systems require a carrier-type signal to work properly, a beam/receiver setup will get bearings on any signal that the receiver can detect. AM, FM, SSB, CW—no matter. Just rotate the antenna and peak up the S-meter or listen for the cleanest, strongest signal.

Want to hunt ATV? Simply aim the beam for the least snow and fewest ghosts. What about pulsed noise sources? Peak them up on the meter or by ear using the receiver's AM or SSB mode.

Radon Gas?

So what do you tell those passers-by who ask if you're using that big antenna to watch the ball game? I've been tempted to say that it's a setup for searching out radon gas levels, and I'd be happy to check out their houses for a small fee!

Actually, such encounters are an excellent way to get good PR for our hobby. Anyone who is interested enough to ask will probably be interested in hearing about ham RDF and the public service it can provide. If the ham turns the inquirer away with a flip answer, he'll just reinforce the "hams are weird nerds" stereotype.

On the other hand, I know there's no time to explain the finer points of transmitter hunting to a stranger while you're on a timed hunt. So I came up with an information sheet on T-hunting and ham radio that you can give to curious onlookers, and let you get on with your hunt. I'll be glad to send you one (then you can make your own copies), if you'll send me an SASE. While you're at it, tell me about the hunts in your town.

Next month this column will feature more on beam hunting, including plans for building a popular hunting quad. ■

Continued from page 8

has a tremendous lot to offer America. Indeed, with technology being the future and with consumer electronics being the engine that drives technology—and the real power behind the Japanese miracle—we have no other practical plan for regaining our technological superiority other than through a reborn American amateur radio community.

It's a big responsibility and we're only 200,000, so there's no room for anyone to beg off. You're not too busy. You're not too short of money. You're not too old. Every one of our 200,000 active hams needs to accept the responsibility to make a difference. When one single person can make a difference, imagine what 200,000 can do!

Stay Informed!

Less than half of the active hams are reading *73*. I need your help to get 100% of them reading *73*. What can I do to get 'em? YOU tell me. I don't ask that *73* make money, only that it doesn't lose so much that it goes out of business. You can help by finding out why your ham friends are not reading *73* and letting me know. Do I need to change *73*? The previous owners tried cutting my editorials and that wasn't the answer. Please start asking and then drop me a note. Is *73* boring? Yes, of course I want to publish more construction projects—and we've got some coming. But finding 'em these days is tough. I may have to have them translated from the Japanese ham magazines, since they're doing most of the building today.

If we had more advertising we'd have a fatter magazine—the way it used to be ten years ago. Ask the advertisers why they are not advertising in *73*. I know that those who are, tell me their ads sell their products for them. Getting people to change isn't easy—and that includes non-advertisers as well as non-readers.

If any of you are involved with your educational systems in your states, I'd love to have you arrange for me to talk with the decision makers about instituting an eight-year course in the fundamentals of electronics, communications and computers—grades 5–12. Every youngster in America should take such a course—and it should be fun. I've got a way, as I've written several times, to provide it so that there isn't any need to train science teachers first. It's a sneaky approach that I believe can bring us tens to hundreds of thousands of new hams a year. We could use 'em. I haven't found any educators who don't believe my system will work—and I've discussed it with over thirty college presidents so far.

Now, those pesky parents—I've a plan for getting them onto their kids' cases too. This involves producing some videos to help parents come to grips with their responsibilities as parents. You haven't even seen a PBS program covering this problem—and it needs the impact of a video.

The average father talks with his children less than 15 minutes a day. We see what a fantastic difference parental involvement makes with our new Asian families, where their kids are running circles around American kids. We need some videos to help parents work with their kids and to motivate them. Such a series should make a bundle. Anyone want to work with me on the project?

You might note that none of my proposed solutions involve any heavy government investment. No spending. To the contrary, my proposals will end up saving the government billions. This could go toward reducing the deficit, but being practical about that I expect that as soon as a billion is saved that liberal congressmen will find at least two ways to spend every dollar saved.

I believe that tens of billions in military and government expenses could be saved, if we set up a federal commission to protect whistle-blowers. Virtually every government and military ham I meet has a long list of horror stories of flagrant waste, but they don't dare say anything about it or they're washed up. And why bother if the billions saved will just be thrown into some other stupid government project or given to some dictator to keep in Switzerland for his retirement?

So let's work toward rescuing amateur radio—toward a temporary block on further frequency losses—toward rebuilding our school radio club infrastructure. If we can get the 200,000 active hams all reading *73*, perhaps we can make all this happen. Do you know any other approach that has even a slight chance of working?

ABOVE AND BEYOND

VHF and UHF Operation

Pete Putman KT2B
3335 Fieldstone Dr.
Doylestown PA 18901

QTH K2OWR

As I write, the fall tropo season is well underway, and the September VHF Contest is a pleasant memory. Although conditions were not as good as expected, our multi-operator group still had a great time, and even got a few licks in during the Sunday aurora session on 6, 2, and 220.

Understandably, most of the SCORE members were a bit weary after the ambitious Chincoteague trip in June! Disassembling and reassembling your station every few months is a lot of work and gets to be a bit tedious. However, a few of the gang decided to have a "low-key" effort from Bill Radice K2OWR's QTH in the hills of northwestern New Jersey, using the long-dormant K2XR callsign.

Only Bill, Ivars KC2PX, and I were present from the June operation. Jerry Meckenberg K2JWE agreed to put in a few hours, and we recruited three new operators from the local area—Leroy KA2UHS, Harry N2GUF, and Bill KB2ENE. None had any practical VHF/UHF contesting experience, but all turned in a first-class job with a little bit of encouragement.

Bill's house is in an enviable location, sitting near the top of a long ridge 1,000 feet in elevation that forms the northern side of the Pequest River valley. It's a rural, scenic location, with great views in every direction except west by southwest. Bill designed his own modular house and (with great difficulty) managed to get all the pieces in place at the edge of a steep cliff. It was just a matter of time before two towers sprang up, just up the hill, topping out at 70 and 50 feet, carrying a full load of yagis for 50, 144, 432, and 1296 MHz.

Most of the antennas and one tower trailer from Chincoteague wound up in Bill's yard. It was a simple matter to round up the other trailer, plus additional yagis from Ivars, and our "low-key" effort shifted into high gear rather quickly. The band complement expanded to include everything from 50 MHz through 2304 MHz, with dedicated stations on each band scattered throughout the house, and even down the hill in a mobile camper.

Murphy Strikes

Murphy hit us hard the Friday before the contest. I had spent over an hour repairing the direction indicator in a CDR CD-45 rotor, and installed it atop the W-67 crank-up to support 2 x 19 yagis on 220, 4 x 25 yagis on 2304, and 4 x 23 yagis on 903.

Photo A. Putting together the 220/903/2304 station.

All went well until the tilt cable—that everyone was "going to get around to replacing someday"—snapped with the tower at about 45 degrees. Our microwave hopes nearly went up in smoke with a thunderous crash, as the tower dropped back into its cradle and (A) smashed two of the 2304 antennas beyond recognition; (B) severely bent several elements on the 220 yagis; (C) snapped four elements clean off the 903 array; and (D) completely flattened a 5-foot aluminum ladder.

To make matters worse, the impact sheared the base of the CD-45 completely off the rotor, cracking the bottom casing in half and stripping two bolt threads—an hour's work completely wasted. Leroy, Bill, and I just stood there in shock for about five minutes. It was amazing that none of us was lying prone on the ground waiting for the rescue squad!

No sense feeling sorry for ourselves. I pulled out my portable machine-shop-in-a-toolbox and began repairing the 2304 yagis, that were ready for the scrap heap. Leroy set about removing the other yagis so the mast could be extracted, and Bill made sure the heroic ladder got a decent burial for its valiant efforts under attack.

The W-51 trailer had originally been intended to carry the 4 x 17 element 2 meter array that proved so successful at Chincoteague, but our near disaster quickly changed those plans. Believe it or not, we were able to repair all of the antennas and reinstall everything atop the W-51 in just under two hours, snatching a victory of sorts from the jaws of defeat. Just for laughs, we added a single 7-element yagi for 440 MHz FM before the W-51 was cranked up—this time with no sudden surprises from Mr. Murphy!

Loaded for Bear

The station complement was competitive: 1 kW to a Hy-Gain 8-element yagi atop the 50-foot tower on 6; 1 kW to 19 elements at 70 feet on 2; 600 watts to the 2 x 19 array at 60 feet on 220; and 2 x 22 elements with 700 watts on 432 at 70 feet. In addition, we ran 20 watts to 92 elements on 903; 60 watts to 92 elements on 1296; and finally, 8 watts to 100 elements (give or take a few) on 2304. We were truly loaded for bear!

I printed up a few explanatory sheets to give our three new operators a quick introduction to the world of grid chasing, including the principles of making schedules on other bands to boost the overall grid count. Boy, did they pick that up quickly! As the contest evolved, Bill's QTH resembled a firehouse with operators constantly running between 2/432/1296 upstairs and 220/903/2304 downstairs with little slips of paper. I suggested turning a spare mast into a fireman's pole to save time. (The suggestion was promptly ignored.)

The 6 meter stalwarts were about a hundred feet down the road, ensconced in Bill's comfy camper and connected to the "firehouse" by an intercom system. Some of the guys preferred to sprint down the road to the trailer with sked information for exercise. This system worked! Our own record was working W9IP/2 from FN24 on four different bands within the space of five minutes, using both the intercom and "winged messenger" systems.

Conditions and activity levels were fairly typical for September. Plenty of grid squares were active, but the number of signals was down considerably from June. Tropo conditions were mediocre at best, except for an occasional "ping" from the Midwest, such as a contact we made on 432 into EN72 (southern Michigan) that came as a bolt out of the blue. The number of stations we had to operate made up for the activity levels, as we spent considerable time making long-haul contacts on 903, 1296 and 2304.

Help from the Aurora

Finally, it came, as the old-timers say it always does—an aurora. At first it was just a whisper here and there on 2 meters, then a crescendo of raspy CW signals burst from the noise, signing 8, 9, and even Ø prefixes. The chase was on! Since we had some "hashing" on 2 meters from the 220 station, we decided to stay on 6 and 2 only for the duration of the contest. And a good move it was, as our first 31 contacts during the aurora on 2 yielded 21 new grid squares—even ten in a row at one point!

Six meters was even crazier, working as far west as EN34 in western Wisconsin. But there was plenty of activity to the north and northeast, as we made contacts In

Continued on page 102

Number 31 on your Feedback card

73 Review *by Pete Putman KT2B*

Coaxial Dynamics Model 81000-A Directional RF Wattmeter

Coaxial Dynamics, Inc.
15210 Industrial Parkway
Cleveland, OH 44135
216-267-2233
1-800-COAXIAL
Price Class: $159
Elements: $48–$95

Enter the competition.

There's no question that an accurate RF wattmeter can be one of the more useful test instruments in your shack. With it, you can measure forward and reflected power, transmission line loss, and VSWR of antennas and coaxial lines. You can find many varieties of wattmeters in the marketplace, but by far the most accurate are those using directional couplers. To make such a meter usable at any frequency, the detecting element should couple to a section of transmission line of, ideally, 50Ω. This would allow insertion in virtually any section of a 50Q line without affecting the impedance of that line.

Great idea, and it has already been done. (Do thoughts of a winged creature flying about Cleveland, Ohio, suddenly cross your mind?) For many years the industry standard for 50Ω thruline directional-coupler wattmeters has been the Bird Model 43. You can find them everywhere in a variety of applications. Owners of clean used Model 43s often sell them used for more than they paid for theml This phenomenon is due largely to two factors: (1) Bird's almost annual price increases and (2) the virtual absence of competition.

New Kid in Town

Well, hold on to your hats. Coaxial Dynamics, also of Cleveland, produces the Model 81000-A inline directional-coupler wattmeter that works just as well as a Model 43. The design of this instrument is essentially identical to the Model 43: a 50Ω transmission line section runs through the shell. A rotatable diode coupler/detector element is inserted into a socket coupled at the midpoint of the line section. You can rotate it 180 degrees for reading forward or reflected power.

Many different elements are available to cover the 2–1300 MHz range, with power levels from 100 milliwatts to 10 kilowatts (yes—10,000 watts), using various Quick Match connectors. Coaxial Dynamics also makes special elements for use with larger line sections, such as 1⅝" and 3⅛" hard-line. And here's the kicker: All Coaxial Dynamics plug-in elements are fully interchangeable with Model 43 elements. This means that if you already own a Model 43 or two, your existing elements will fit the 81000-A. . . and its elements will drop into your Model 43 nicely. Clever!

The Coaxial Dynamics Model 81000-A. Note the large, easy-to-read meter scale.

There are other similarities between the two lines. One of these is the grouping of elements by power and frequency range (Bird lists them as "Table XX Elements;" Coaxial Dynamics as "Schedule XX Elements"), and the many different kinds of connector options (Bird calls theirs "Quick Change," Coaxial Dynamics "Quick Match").

Not a Clone

Is the Model 81000-A a Bird "clone?" Not entirely. For one thing, the meter scale is considerably larger. Next, the surface contains a small mirror band to make readings easier. On the other hand, the movement is 30 microamperes full scale, like the 43 (the elements otherwise couldn't be swapped). The housing is about 10% larger than the 43, and the front panel slopes backwards from bottom to top, which allows more ambient light to fall on the meter scale. Also, the 81000-A carries two spare elements on the rear panel, as opposed to the sides.

The elements are also similar, being identical in size but different in case markings and colors. One disadvantage of the Coaxial Dynamics elements is their identification system; a five-digit code refers to one of the three Schedules. This is more of a serial code than an identifying mark. For example, a Bird 250 watt 50–125 MHz slug is called a 250B, whereas the same slug in the Coaxial Dynamics line is called an 82025.

How well does it work? Very well. In fact, I was unable to detect any differences between a late-model 43 and the 81000 using both brands of slugs on 50, 144, 432, and 903 MHz. Measurements were made at 10, 25, 100, and 250 watt levels. I didn't bother to print the data simply because there was no significant variation at any power level.

I did check for insertion loss at 1296 MHz using a 25 watt coaxial resistor. With 25 watts of RF from an LT-23S through a short piece of 9913, I connected the 81000-A at the end of the line and installed a Termaline load at the other port of the 81000-A. I measured no reflected power, so insertion loss is certainly better than 1.05:1, as the owner's manual claims.

Verdict

The burning question is: Why should you buy a Model 81000-A instead of a Model 43? Two possible answers are that: (1) You prefer the color blue to gray, or (2) You'd like to save about $20 on the meter and from $2–$6 on the more common elements. If you plan on picking up a wattmeter with 3 elements–say, one for HF and 2 for VHF–you'll wind up pocketing about $30 over a comparably-equipped Bird Model 43. This price difference may or may not be offset by other factors, such as customer support. The 81000-A, however, will do the job every bit as well.

Coaxial Dynamics Model 81000-A RF Wattmeter Specifications

Power Rating	Depends on element used
Impedance	50Ω nominal
Insertion VSWR	1.05:1 max. with "N" connector
Weight	3.6 lbs.
Element weight	3 oz.
Accuracy	5% of full scale
Size	5" W x 7¼" H x 4" D

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WANTED: Yaesu FT-625RD, FT-627RA, or FT-680R. Also wanted: ICOM IC-505, IC-551, IC-551D, IC-560, or IC-502A. Reasonable. Jim, 469 Jayson Avenue, Pittsburgh PA 15228. BNB815

SLEP SPECIALS, TEN-TEC, NEW BOXED LATEST PRODUCTION MODELS, USA MADE, 561 CORSAIR II, 562 OMNI V, 585 PARAGON TRANSCEIVERS, 425 TITAN 1.5KW LINEAAR AMPLIFIER, HERCULES II 1KW SOLID STATE LINEAR AMPLIFIER, 229B ANTENNA TUNER, MOBILE HF ANTENNAS, PLUS ACCESSORIES, ALL MODELS, TAKE GEAR IN TRADE, VISA/MC OR CHECK. FOR BEST DEAL, WRITE OR PHONE BILL SLEP, 704-524-7519, SLEP ELECTRONICS COMPANY, HIGHWAY 441, OTTO NC 28763. BNB816

COMPUTERIZE with the "Amateur Radio Operating System." This MS/DOS based software features auto-logging, QSL management, AWARD summaries, Contesting, and MORE. Base System $39.95, Demo disk $10.00 (credited). SASE brings details. Fundamental Services, 1546C Peaceful Lane, Clearwater FL 34616. BNB817

FREE HAM EQUIPMENT, details $1. P.O.B. 1631, Arvada CO 80001. BNB818

WANTED: Panasonic RFB600, Grundig Satellite, Magnavox D2999 or any good quality general coverage multi-band receiver. Wade, 657 14th Ave., Prospect Park PA 19076. BNB822

COMMERCIAL HF CW IDENTIFIER: Quartz 10-Minute Timer, Sinewave Oscillator, Complete Instructions, Guaranteed, $79.95. OMR, 6126 Rex Drive, Dallas TX 75230-3429. (214) 891-0509. BNB823

MACINTOSH, ATARI XL/XE/ST & AMIGA Amateur Radio software. We have several public domain disks available for trade or $4.00 each. Send business size SASE specifying computer for list. Write WA4EFH, P.O. Box 1646, Orange Park FL 32067-1646. BNB824

PRO2004 OWNERS INCREASE CHANNELS to 400, SCAN SPEED TO 30 CPS. COMPLETE KIT $35.00. INSTALLED $55.00. LESTER JERNIGAN, P.O. BOX 2406, ORANGE PARK FL 32067-2406. BNB825

WANTED: SB220 or SWAN MARK II Linear—AS IS condition—Samuel Lack W5DOE, Box 577, DeRidder LA 70634. Call collect (318) 463-8964. BNB826

WANTED: Xtal controlled 220 MHz transceivers (such as the model made by Midland). (517) 627-4095. 10100 North Cochran, Grand Ledge MI 48837. BNB827

NEED SCHEMATIC/SVC MANUAL for Hallicrafter SX-140. Will pay cost and parcel. Pedro L. Candelario, Bobadilla JT-1, Levittown, Puerto Rico 00949. BNB828

QUALITY HAM SOFTWARE for the IBM-PC and compatibles. Many shareware and public domain programs for all aspects of ham radio. Business SASE for catalog. JK&S, Dept. SB, P.O. 50521, Indianapolis IN 46250-0521. BNB829

WANTED: HW-101 and HP-23 for parts. Need not be working. Write stating condition and price. RTO, 4166 Maple St., Berrien Springs MI 49103. BNB830

Number 33 on your Feedback card

INDEX: January

Issue #340

HAMSATS

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
14714 Knightsway Drive
Houston, TX 77083

Hamsats a Year Older

The dawn of a new year represents new beginnings. The new year brings the inevitable resolutions. Some good ones for the current or potential satellite operator include joining or renewing AMSAT membership, finishing antennas or radio projects, and getting more operating time on the satellites.

For example, AMSAT-OSCAR-7 was last heard in the summer of 1981. There have been no contacts via this satellite since then. Unless something remarkable happens, it is history. The shortwave bands won't disappear tomorrow, but we can only guess the life spans of RS-11, Fuji-OSCAR-12 or AMSAT-OSCAR-13.

Amateurs who are already active via satellite, and who have all the HF, VHF, UHF, and microwave equipment they need for satellite fun, might consider helping someone else get started with satellite chasing this year—explain it, or better yet, demonstrate a functional earth station.

Station descriptions can be pieced together by reading through all of the Hamsat columns during the last two years. New rigs, antennas, and accessories can out-perform the older equipment, but many of the systems that performed well for A-O-10, still do great for A-O-13, five years later. What is the average A-O-13 operator using today?

What It Takes

Many how-to's written on satellite operation tell you that you can make contacts with simple systems using inexpensive radios and home-brew antennas. They are right. Many AMSAT-OSCAR-10 enthusiasts proved that (with the right conditions) a few watts to a small manually-pointed yagi, or more power into a mobile magmount, provides good uplink signals; and that a dipole hung on the wall, followed by a small receive converter and an HF rig, can hear signals from space. It may not be a piece of cake at times, but it has been done many times.

Successful A-O-13 Activity

The following is not a description of a QRP (low power) satellite station or an indoor antenna system, but a brief guide for successful A-O-13 Mode B activity.

The easier a station is to use, the more it will be operated. Very rarely does a new satellite chaser put together all of the ingredients for the ultimate earth station at one time. It is a process of experimentation and learning.

So, how does one get a station ready for A-O-13? The most popular transponder on A-O-13 is Mode B. This requires an uplink signal from the operator, using CW or lower sideband from 435.423 to 435.573 MHz. This 70 cm up, and 2 meter downlink-type transponder worked successfuly on A-O-7. For A-O-13, most contacts are made on uplink frequencies close to 435.500 MHz. Downlink reception is from 145.975 to 145.825 MHz, CW, or upper sideband.

Note the frequency guide in last month's column. The Mode B transponder is inverting, thus a lower sideband transmission on 435.443 MHz will result in an upper sideband signal on 145.955 MHz, while an uplink on 435.553 MHz will come out on 145.845 MHz. CW activity is usually heard below 145.900 MHz, while sideband users stay above 145.900 MHz.

Since the VHF and UHF bands used by A-O-13 are primarily line-of-sight, satellite access is only possible when A-O-13 is above the operator's horizon. The best way to predict when A-O-13 will be available from a specific location is to use a good satellite tracking program on your computer. AMSAT offers software for many computers. Some programs provide simple tabular listings showing basic tracking information, while others can produce world maps with real-time, multi-satellite tracking. Regardless of the program's complexity, the point is to know when to operate and where to aim the antennas. If a computer is not available, there are mechanical aids for tracking, or a friend may be able to print predictions. Due to the elliptical shape of A-O-13's orbit, guessing the satellite's position won't work. Long-term commitment to satellite chasing requires access to a computer with tracking software.

Most active operators have multi-mode, 2 meter, and 70 cm transceivers. Commonly heard rigs include the Yaesu FT-726R or FT-736R, the ICOM IC-271 and IC-471 pair (A or H suffix), the IC-275 and IC-475 pair (A or H suffix), and the Kenwood TS-711A and TS-811A pair. For those with the H-suffix ICOM rigs (high power of 75 watts) no external amplifiers are used. Others with 25 watt radios usually buy an amplifier. The idea is not to overpower the satellite, but to have the extra output available when the satellite does not favor the user's location. An example is when A-O-13 is at apogee (highest point of the orbit) with its gain antennas pointed away. Amplifiers commonly used include Mirage, TE Systems, and RF Concepts. You can expect consistent and satisfying results with 50 to 100 watts.

Quality coaxial cable and good antennas up in the clear round out the complete earth station. For the cable, most use Belden 9913 coax with N-connectors for the slightly larger center conductor of the 9913. Keep the coax runs short. If the rig or antennas use SO-239 connectors, then use PL-259A connectors (Teflon dielectric) on the cable. Avoid jumpers and extra coax adapters.

Satellite antennas don't need to be high; they just need to be able to "see" the sky. It's best to have an unobstructed view of the horizon in all directions. Trees and buildings attenuate both received and transmitted signals. Commonly used antennas are circular-polarized, commercially-built crossed yagis. Manufacturers include Cushcraft, Telex/Hy-Gain, Mirage/KLM, Tonna, and others from Spectrum International. The first three brands are the easiest to find.

The AOP-1 package from Cushcraft includes a 20-element 2 meter crossed yagi, a 16-element 70 cm crossed yagi, and a mounting boom with a mounting plate for the Alliance U100 rotor (for elevation control). It does not come with polarization switching, and it does not use stainless steel hardware, but it is the least expensive. The cable harness typically is set for RHCP (right hand circular polarization) to conform with most satellites. You can buy the antennas, crossboom, and mounting plate separately, if necessary. A polarity switch is available for the 70 cm antenna and a 10-element 2 meter crossed yagi is an alternative for those with space constraints. The smaller antenna exhibits less gain.

The OSCAR Link antenna system from Telex/Hy-Gain offers advantages over the Cushcraft system, but averages about $100 more. It includes a 16-element 2 meter crossed yagi, a 30-element 70 cm crossed yagi, and a heavy-walled fiberglass crossboom. Hardware is stainless steel with ultra-violet stabilized plastic insulators. Many other items have been carefully engineered, including polarization switching relays rated at 200 watts. For a cost-effective system with excellent performance, this antenna array is the best choice.

The finest antennas are made by Mirage/KLM. Two versions of the 2 meter crossed yagi are available. One has 14 elements and the other has 22. Just the 2M-22C (22-element antenna) costs more than the complete Cushcraft package, but it includes a switch and stainless hardware. For 70 cm there is either an 18-element or 40-element antenna.

Most stations have preamps. For a few, signals from the satellites are sufficient without a preamp. These stations have state-of-the-art radios with GaAsFET front ends and large antenna arrays. For those with long coax runs, preamps are placed at the antenna. This way, weak downlink signals are amplified before they are lost in the coax. With a short coax run, you can place the preamp near or in the radio. Advanced Receiver Research, Hamtronics, Landwehr (from Henry Radio), and Microwave Modules Ltd. (from Spectrum International) manufacture many of the commonly used preamps.

There are many ways to get a functional satellite station on the air. Other manufacturers of VHF and UHF rigs and antennas exist, and tracking software has been written and sold by companies and individuals other than AMSAT. Several transponder modes are available via A-O-13, but getting a fully functional Mode B station on the air is an important start. ■

For further information, consult *The ARRL Handbook, The ARRL Operating Manual, The Satellite Experimenter's Handbook*, the many AMSAT publications, and the AMSAT HF and satellite nets.

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
PO Box 1079
Payson AZ 85541

January 1989

January will provide some excellent DX on all bands from 160–10 meters. You may find, however, that the week between the 9th or 10th and the 16th or 17th will be spotty. In fact, days in these two periods may be poor with high magnetic index (A) values due to an unsettled-to-active geomagnetic field. Otherwise, static levels will be generally low during the month, and great DX should be available on the lower HF bands of 160, 80, and 40 meters.

Thirty meters will also be good, but, as the frequency increases, the HF high bands will close earlier. Ten will close just before dark on most days, and 15 meters will soon follow. Twenty will stay open quite nicely for an hour or two after local dark.

January is not generally considered a good DX month, but with sunspots increasing rapidly and solar flux values holding well above 150, the conditions will be better than they have ever been in a long time.

For those interested in astronomical events, Earth will be closest to the Sun on January 2, the Moon will be closest to Earth on the 11th, and a full Moon will occur on the 22nd. No eclipses are in the forecast for January. January is not exactly a "ho-hum" month, but it is generally far less exciting than March or September.

You may find some very good VHF openings in January, however, so keep your ears tuned. As always, listen to WWV at 18 minutes after each hour for up-to-date broadcasts of solar flux and geomagnetic (A) and (K) indexes. The higher the flux and the lower the (K) and (A) indexes, the better conditions will be for propagation on the HF bands.

The Source

Readers often ask me about the source of my predictions. I use the *Shortwave Propagation Handbook—Principles, Theory, Predictions* edited by George Jacobs W3ASK and Theodore J. Cohen N4XX. The edition I have was published in 1979 by the Cowan Publishing Corporation, 14 Vanderventer Avenue, Port Washington, NY. The book is priced quite reasonably at under $10.

The book assumes the reader is a neophyte to propagation matters and gives a good understanding of the mechanisms of long-distance transmission and reception of radio signals.

If you read this book thoroughly, you'll be able to make your own forecasts with reasonable accuracy for any time of the year, for any year in any sunspot cycle. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20	-	-	-	-	20	20	-	-	-	15
ARGENTINA	20	40	40	40	-	-	20	15	15	10	10	15
AUSTRALIA	15	20	20	-	40	40	40	-	-	20	20	15
CANAL ZONE	20	20	20	20	20	20	20	15	10	10	15	15
ENGLAND	40	40	40*	40*	-	20	15	10	15	20	20	-
HAWAII	15	20	-	-	-	-	20	20	20	10	10	15
INDIA	-	-	-	-	-	-	20	20	-	-	-	-
JAPAN	15	20	-	-	-	-	20	20	-	-	-	15
MEXICO	20	20	20	20	20	20	20	15	10	10	15	15
PHILIPPINES	-	-	-	-	-	-	20	20	-	-	-	-
PUERTO RICO	20	20	20	20	20	20	20	15	10	10	15	15
SOUTH AFRICA	20	40*	-	-	-	-	20	10	10	10	15	20
U.S.S.R.	-	-	-	-	-	-	20	15	20	20	-	-
WEST COAST	15/20	20/40	80	160	160	160	-	-	-	10	10	15

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	-	-	-	-	-	-	20	-	-	-	15
ARGENTINA	20	20	20	40	40	-	20	20	15	10	15	15
AUSTRALIA	15	20	20	-	-	-	40	-	-	-	15	10
CANAL ZONE	15	20	40	40*	40*	-	20	15	10	10	10	15
ENGLAND	40	40	80	-	-	-	-	20	15	15	20	40
HAWAII	15	20	-	40	40	40*	40*	20	20	15	10	15
INDIA	-	-	-	-	-	-	-	20	-	-	-	-
JAPAN	15	-	-	-	-	-	-	20	-	-	-	15
MEXICO	15	20	40	40*	40*	-	20	15	10	10	10	15
PHILIPPINES	15	20	-	-	-	-	-	20	-	-	-	15
PUERTO RICO	15	20	40	40*	40*	-	20	15	10	10	10	15
SOUTH AFRICA	20	40	-	-	-	-	-	15	10	10	15	20
U.S.S.R.	-	-	-	-	-	-	-	20	15	20	-	-

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15	20	-	-	-	40	40	40	-	-	20
ARGENTINA	15	20	-	40	40	-	-	20	-	10	10	15
AUSTRALIA	10	15	20	20	-	-	40*	40*	20	20	15	15
CANAL ZONE	15	20	20	-	-	-	-	20	15	10	10	10
ENGLAND	20	40	40	-	-	-	-	-	15	15	20	20
HAWAII	10	15	20	40	40	40	-	20	20	15	15	10
INDIA	-	15	20	-	-	-	-	-	20	-	-	-
JAPAN	10	15	20	-	-	-	40	40	40	-	-	20
MEXICO	15	20	20	-	-	-	-	20	15	10	10	10
PHILIPPINES	10	15/20	15/20	-	-	40	40	40	-	20	-	20
PUERTO RICO	15	20	30	-	-	-	40	40	40	-	-	20
SOUTH AFRICA	20	20	-	-	-	-	-	-	15	10	15	15
U.S.S.R.	-	-	-	-	-	-	-	-	20	20	-	-
EAST COAST	15/20	20/40	80	160	160	160	-	-	-	10	10	15

JANUARY

SUN	MON	TUE	WED	THU	FRI	SAT
1 G	2 G	3 G	4 G	5 F	6 G	7 G
8 G	9 G–F	10 F	11 F–P	12 P	13 P	14 P
15 P	16 P	17 P–F	18 F	19 F–G	20 G	21 G
22 G	23 G	24 G	25 F	26 F–G	27 G	28 G
29 G	30 G	31 G				

Number 37 on your Feedback card

ASK KABOOM

The Tech Answer Man

Michael J. Geier KB1UM
7 Simpson Court
S. Burlington, VT 05403

Bandwidth!

The other day, I was having a nice conversation on 20 meters with a guy who was running S-7 to S-8. Suddenly, another station came on 1 kHz below us, running about 10 over 9, and wiped us out. I went down to his frequency and politely requested that he move, as we were only 1 kHz up. His response: "I'm a kilohertz below you, I shouldn't be bothering you!"

For a moment, I didn't know what to say. Understanding the concept of bandwidth is one of the most basic requirements of station operation (not to mention licensing), yet here was a ham who clearly didn't know (or didn't recall) what it was!

While most hams are familiar with the concept, judging from the QRM on the bands, at least some hams have a less-than-clear mental picture of what goes on spectrally when we speak into our mikes. This month's column seeks to clarify this.

The 3 kHz Range

In a properly operating SSB rig, the transmitted bandwidth is equal to the modulating frequencies. For us, that's 3 kHz maximum, as required by law on the amateur HF bands.

Look at Figure 1. It represents a portion of the 20 meter band. The section over which the curve sits represents your USB signal on 14.300 MHz. Now look at the measure below the curve below the graph. Depending on your sex, voice qualities, what you are saying, and especially the type of microphone you use, the distribution of the transmitted energy may favor the low voice frequencies, high voice frequencies, or somewhere in between. The areas bounded by the curves in the two figures, for example, shows a concentration of voice frequencies in the middle ranges.

For all practical purposes, you are using up your entire 3 kHz allotment at any time. So you're not really on 14.300; you're on 14.300 to 14.303! 14.300 is merely where your carrier WOULD be if you were operating AM and, of course, what your dial or digital read-out shows. It is clear, then, that stations can be 3 kHz apart without interference. (In practice, a bit more room is required because receiver filters are not perfect.)

"Monkey Chatter" and Rumblings

Now, look at Figure 2. If a station has moved only 1 kHz below you, the bandwidths will overlap, and his or her upper voice frequencies will appear where your receiver will interpret them as LOWER frequencies. You will hear unintelligible rumblings. On the other hand, if a station is, say, 2 kHz ABOVE you, you will hear squeaky "monkey chatter" because his lower voice frequencies will appear where your receiver will interpret them as UPPER frequencies.

On LSB, everything's reversed. Your bandwidth extends for 3 kHz BELOW your dial frequency. On the diagrams, the lows and highs will be reversed. Monkey chatter comes from stations below you and rumblings come from above.

Nearly all of today's rigs have a control which allows you to narrow the bandwidth of your receiver and filter out some of the QRM. (A notable exception is the new Yaesu FT-747. Shame!) The technique is pretty effective, especially on the monkey- chatter type of QRM, but the price you pay is that the signal you want to hear is also degraded. Cutting the monkey chatter muffles reception, and reducing the rumbling makes the voice tinny. But, at present, there is just no other way.

"Nearly all of today's rigs have a control which allows you to narrow the bandwidth of your receiver and filter out some of the QRM."

Notch Filters

By the way, reduction of this type of interference is not the purpose of a notch filter. These filters put a narrow, deep null in your passband and are intended only to remove heterodynes ("tuner-uppers"). The null isn't wide enough to remove the wide band of frequencies present in a voice signal.

Finally, don't forget to keep your bandwidth in mind when deciding how close to the band edge to set your dial, or some of your signal could wind up outside the band. A friend of mine forgot this and got a pink warning slip from you know who!

Now that we've vanquished QRM from the bands (hah!), let's look at this month's letters.

Dear Kaboom,

I have a problem. I bought a car with fuel injection, and have I got a noise in my mobile HF rig! It sounds like the ignition, but only on 20 meters. I've never had trouble like this in my other cars. I'm disgusted with this computer junk. What can I do to clean up the noise?

Signed, Annoised

Dear Annoised,

Obviously, something in that car has a harmonic on 20 meters! Generally, computer-generated noise sounds very different from ignition noise, so I doubt that the car's central processor is the culprit. Especially if the noise is very broadband (covering the entire band), I would say it is not caused by a computer.

Does the car have digital instrumentation? Those big fluorescent read-out tubes seem like logical noise suspects to me, but again, the noise should sound very different from ignition.

The most likely cause is from pulses delivered to the fuel injectors, or by good old ignition. As always, shielding wires may help. Also, check to see if the noise is present only when the car moves. Hash could be coming from wheel bearings, tires, the transmission, or any other moving mechanical system.

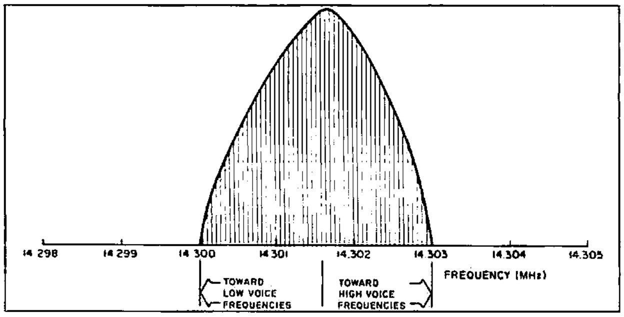

Figure 1. A diagram of a USB signal when the rig is tuned to 14.300 MHz transmit.

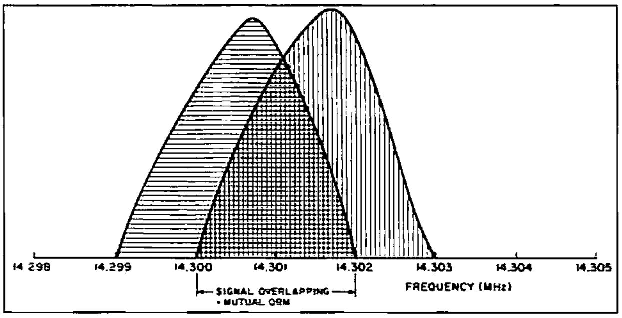

Figure 2. Two USB signals, tuned to 14.299 MHz, and 14.300 MHz respectively. Note their overlap, which extends from 14.300 to 14.302 MHz. When signal bandwidths overlap, you will hear, on the frequency in question, rumblings on its lower frequencies and monkey chatter on its higher frequencies.

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

Korea and the Olympics. *Sometimes things just plain go wrong—and our planned coverage of the Olympics just plain went wrong. Byong-Joo Cho HL5AP did his part, but a combination of postal services and office confusion led to our failure to get two of his reports and to temporarily (from February 18 to September!) mislay another one. HL5AP earned his subscription to 73 and he'll get it; for those of you who may have been looking for our coverage—apologies. CCC hopes you got the information you needed elsewhere.*

As usual we have much more material than can fit in these pages, but the IARN information from Sam Voron VK2BVS, Peter ZS6ET's first Hambassador report from the Republic of South Africa, and Hambassador UA9MA's material clearly deserved priority attention. (Even so, two-thirds of the report from ZS6ET will have to be held over for the future.)

Anyway, HAPPY NEW YEAR to those who are starting 1989 on the 1st of January (with the 2nd being Dia del Ano Nuevo, Nouvel An, Neujahrstag, and New Year's Holiday in Scotland), and a plain old wish for happiness to those whose new years begin later; we'll celebrate the dates of theirs at the appropriate times. Other January dates to note for your OSOs: January 1 is Haiti's Independence Day (on the 4th for Burma and the 31st for Nauru); 7—Ethiopian Christmas; 9—Martyrs' Day, Panama (the 29th for Nepal); 15—Adults' Day, Japan; 23—National Holiday, Australia; 24—Economic Liberation Day, Togo; 26—Anniversary of the Proclamation of the Republic, India.

Roundup

Australia. (And Jamaica, USA, El Salvador, Mexico, New Zealand, Great Britain, Germany, Belgium, Sweden, Israel, Cayman Islands, United Kingdom, Japan...other countries).

HURRICANE GILBERT

Emergency.......!

The following is from a report by the IARN Director for Australia, Sam Voron VK2BVS (4071066), 2 Griffith Avenue, East Roseville 2069, Australia. Chris CK3YID in Melbourne, 036014222, has just attempted to telephone Glenn Baxter K1MAN (Network Manager of the International Amateur Radio Network (IARN) in the USA... he is told K1MAN busy handling emergency traffic...something about a hurricane in the ocean off the eastern US coast...halfway around the world...

Nothing to concern me, weather lovely in Sydney. But let's tune in on NBC's "Today" show, which is aired every night over a VHF Sydney commercial TV channel...

Jamaica hit by biggest hurricane ever recorded in the northern hemisphere, 500 miles wide...

Mexico City and San Salvador were halfway around the world, too, and they sure needed all the help Australian hams could give...

The Australian Traffic Network is activated...VK3CKK 037291624 notified Red Cross ...VK6OP 092774661 and VK6RQ 092771514, Perth, to handle Red Cross-referred calls on health & welfare matters... 14.275 MHz declared emergency frequency (with ±5 kHz guard band), to be controlled by IARN to carry messages from the Jamaican Defense Force station 6Y5B64...many on this frequency because all power, phones, navigational aids at airfields out: aircraft, US State Department, Salvation Army, Red Cross... only well-prepared hams, with generators and fuel, able to provide vital remaining links... 14.325 MHz (±3 kHz), other FCC channel for emergencies, controlled by National Hurricane Center in Miami...hurricane planes use this as they fly through the storm to measure and track it...

Australia and New Zealand relay important info when conditions make coverage difficult...we watch the Caribbean and jump in when needed...over 100 health & welfare messages generated now, relayed to Jamaica through the US since no third-party agreement with Jamaica—so direct service without delays involved when third-party agreements get negotiated before help can be provided...

New Zealand authorities meanwhile ruled that NZ radio amateurs could not help the public despite no telephone communication existed...G4SCA on British RAYNET (the RSGB emergency group) activated and helping the British High Commission... DA2GY in Germany active as well as full US Army Military Affiliate Radio System (MARS)... Belgium, Sweden also; all providing health & welfare message help...Israel amateurs stay alert....

Weekend of 17 September coming up; would everything settle down so we can go ahead with our annual 48-hour Amateur Radio Display at El Park, which was supposed to coincide with our simulated emergency test?...

Cayman Islands hit...storm headed for Mexico...annual Australian Fun in the Sun and Under the Moon amateur radio display and simulated emergency test cancelled...five US amateurs deployed to set up facilities in Jamaica—Dave K2BPP, Ralph N4HTU at Montego Bay with access to commercial telephone satellite link...Bill WB2TUU with Oral Roberts medical team near Kingston...Bob N4MHV at Sandy Bay...Al W9ELR at Kingston Salvation Army station....

September 19: Australian Traffic Net sends ***Happy Birthday*** *to IARN: it's three years since the Mexico City earthquake and the birth of IARN...*

Relief agencies not able to send in medical volunteers without assurance of radio amateurs available full time and US volunteers in Jamaica have to leave (a wife having a baby, etc.) and new ones getting hard to find...United Kingdom offers two, Australia requested by IARN to send one, Japan asked for volunteers...as of September 20...no transport available for non-US volunteers, but Gordon VE3FBU an exception—accompanied Jamaican Consular General, set up communications at Runaway Bay, and this message broadcast:

Situation in Jamaica now urgent. Need food, building material, antibiotics of all kinds, clothing. We have no beds and water is very bad. The people of Jamaica are making all efforts to ensure all tourists are being taken care of.

Australia active 0500 to 1000 hours universal time when, although many net control stations monitoring 14.275, North America mostly asleep and/or coverage into Jamaica difficult...so manning net control...assisting traffic from Europe to Jamaica and Jamaica to US, so Jamaica stations can come on frequency anytime, get messages off, and go off the air to conserve fuel or batteries...Ashley 6Y5GR can operate only Morse code, battery low, but reports excellent, relayed to US: all water has to be boiled, bananas and sugar cane all gone ...VE3FBU reports people sucking on sugar cane to survive... above message causes Australian Dept. of Foreign Affairs to donate $20,000 to help Jamaica...US asked for $400 million: 95% of Jamaica's economic base destroyed...

October 1, 1988 summary (as of this writing). 14.275 remains as the emergency frequency and IARN continues to look for volunteers to go to Jamaica to man field stations. More Jamaica stations coming on the air as the president of the Jamaica Amateur Radio Association (JARA), Selvin 6Y5SG, mobilizes resources. Dave K2BPP draws up disaster communication plan, is debriefed by US representative assessing Jamaica's needs. IARN has donated quantities of gear—aerials, generators, you name it—personally owned as well as from AEA, Heath, Tandy, others.

I am proud of the way so many newcomers to amateur radio became so fully involved in this emergency, and want to thank all US Novices, Technicians, and other 10-meter operators who monitored 14 MHz and kept Australia fully informed when 14 not open to Australia. This worked so well that from now on when a disaster hits there will be an Australian station looking...into the USA in the US Novice voice band, 28.3 to 28.5 MHz as a part of our plan for the Australian net.

The IARN now is seeking any volunteers whether with amateur licenses or not, to serve as go-betweens between radio ops and the local people. On the 10-meter band from Australia, I have been asking USA Novices and Technicians to contact the public via local radio stations, talk shows, CB airwaves, SWLs, scanner listeners, to tell that volunteers are needed to be the eyes and ears of Jamaica.

Volunteers can always phone Glenn Baxter K1MAN (207) 495-2215. or FAX (207) 495-2069. [Ed. note: As of January the foregoing may be out of date, but the need for IARN volunteers to be available never is.—CCC]

Japan. From *The JARL News* for August: "It is essential that all hams be aware of the current worldwide trends that affect amateur activities. Amateur radio communications means worldwide communication and thus worldwide interaction." Living up to this, JARL sent a delegation to the Region III annual meeting in Seoul, South Korea (in October), which included the president, vice president, and managing director (JA1AN, JA6AV, and JA1HQG). "Japan has the most amateurs in the world and is expected by other countries to play a leadership role in Region III and shoulder responsibility for the development of international amateur radio."

GREAT BRITAIN

Jeff Maynard G4EJA
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Hawley Hill
Camberley GU17 9JO
England

The UK Scene The major news is the publication of the new UK amateur license by the UK regulators, the Department of Trade and Industry. It incorporates a number of significant changes, all of which are for the better. Although largely cosmetic or administrative, they have relieved the amateur of a number of bureaucratic chores and should, if nothing else, ease the conscience of those who did not fully stick to the rules.

Until *now* a multipage document, the license is in two parts. A single-sheet validation document confers legality and is renewed annually (when the fee is paid!), and a separate booklet sets out the terms and conditions of the license. The same documents serve all types of amateur stations—club, reciprocal, maritime mobile (but not aeronautical mobile, despite the efforts of the RSGB).

The Europeanization of the UK continues apace with the adoption in the new license of the standard CEPT draft agreement, allowing visiting CEPT license holders to operate in the UK and UK amateurs to operate in most European countries without special permission. (CEPT is the European PTT 'club' which sets many international telecommunications standards.) US amateurs can still, of course, apply for a reciprocal license.

Other changes:

• The rather strange UK suffix /A (for operation from a so-called 'alternate' address) has been replaced with /P for operation away from the main station, and may be used for unlimited periods instead of for only four weeks at a time.
• The DTI has recognized the arrival of the computer age and now permits the station log to be kept on magnetic tape or disk and has relaxed rules defining what must be recorded.
• Computer buffs can now legally operate their 'digipeaters' and can receive and transmit digital messages without the (theoretical) need to review each one.
• Low power beacons may now be set up without special permission, and low power links are OK for *remote* control.
• When operating other than with telephony, it is no longer necessary to ID with a CW transmission of at least 15 wpm—it can be sent in Morse at any speed. When retransmitting a recorded transmission from another station, it no longer is required that the recorded callsigns be deleted before retransmission.
• Restrictions have been removed for operating an amateur station on behalf of social organizations—such stations are no longer required to notify the DTI of their names. (Helpful. I remember the problems of trying to organize GT4EJA/MM for charitable purposes a few years ago.)
• And it is now permissible to conduct crossband contacts using receive frequencies not licensed in the UK (but presumably legal *in* the country of origin).

The very observant of you might have noticed all-American spelling this time (license not licence, organization not organisation). This is due to my use of the US version of a word processor (Professional Write); I now have an IBM PS/2 operating under PC-DOS. Good news in that the IBM is much faster than my old Apple 2 and much more versatile and I have access to a wide range of software. Any helpful contributions from you would be most welcome because the bad news is that all my amateur software (SSTV, RTTY, CW send and receive, satellite orbital predictions) is no more, and I don't know what is available. While home computers are popular in the UK, things tend to be home-grown nonstandard such as the BBC. There is, therefore, a complete lack of amateur software for industry standard machines. What PC-DOS program disks do you have?

HONG KONG

Phil Weaver VS6CT
PO Box 12727
Hong Kong

They say lightning never strikes twice; I sincerely hope that this is true as once again HARTS suffered a major loss of equipment when the digipeater operating very successfully on 29.010 MHz was zapped by lightning in early August, leaving the antenna looking like a sad tail after the night before and the equipment full of little holes! I had never seen the likes of it. We still have not resumed that service [*written in mid-September—Ed.*] but I am hoping that the two beacons which have been established for a few years will be back up on the air shortly, after having been down for reconstruction of the building they are in. To remind those interested, the 10-meter beacon will be operating on 28.290 MHz and on 6 meters at 50.075, with the callsigns VS6TEN and VS6SIX respectively.

After my departure from HARTS (see column in the June, 1988, issue) I established a new society aimed at providing service for the expatriate community in the form initially of the provision of an English-speaking repeater. This is up and running on 145.575–600 with a CTCSS tone needed on the transmissions. If you are coming to Hong Kong and would like to learn more, drop me a line *at the above address* or phone me on arrival at 5–772313. The group is the English Language Amateur Radio Communications Society (ELARCS), and we have quarterly meetings at which all are welcome.

The PO address above is because I expect to move into a new apartment the first quarter of 1989 and don't yet have the new address. The saga of the flat move is an ongoing pain in the neck—should have moved a long time ago but a fire in the high rise, put out with helicopters using salt water from our 'fragrant' harbor, meant that the top two floors had to be demolished and reconstructed!

SOUTH AFRICA

Peter Strauss ZS6ET
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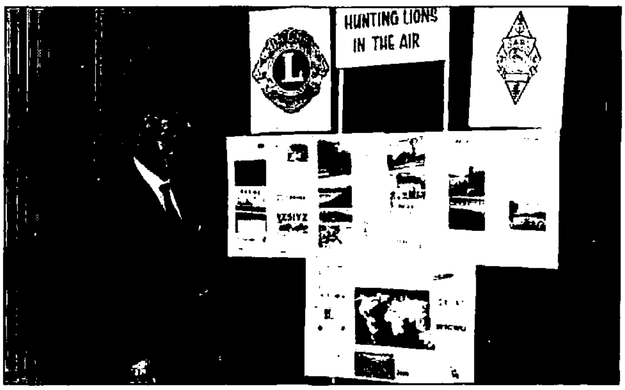
Northcliff, ZA-2115
Republic of South Africa

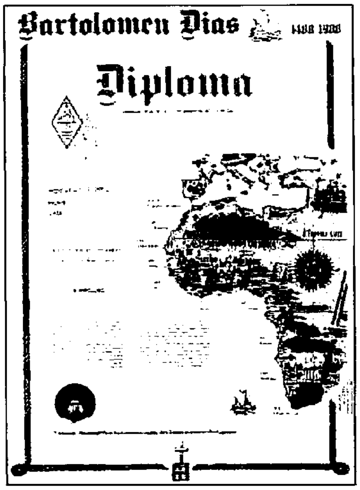
Guest licenses in South Africa. South Africa decided in 1980 no longer to follow the example of the British and US administrations, as they issue licenses to bona fide tourists only if a bilateral agreement has been concluded between the home country of the tourist and the administration of the country to be visited. In South Africa this was considered discriminatory against tourists from rare DX countries whose administrations would not be willing to conclude an agreement for maybe one tourist in five years.

After extensive research by a select committee of SARL (the South African Radio League) into license procedures of other coun-



Lion Bob ZS1ABO, coordinator of joint amateur and Lion activities in South Africa. (Photo by Bob Adshade)

tries, a proposal was submitted to the authorities with the result that since 1981 any amateur from any country may apply for a 3 month permit to operate while in the Republic of South Africa. A fee of Rand 12 (approximately US$5) is payable on arrival. Two license classes compatible with the CEPT class I and CEPT class II are available. (No compatible license class to the US Novice license exists in South Africa.)



In order to cater for amateurs entering for longer periods and to allow for the permanent conversion of foreign licenses to South African callsigns, agreements with Israel, Portugal, the German Federal Republic, Chile and the USA followed. Agreements with Great Britain, Swaziland, Zimbabwe, Botswana, Bophuthatswana, Venda, Transkei, South West Africa and Ciskei have been in force for some time. Amateurs from agreement countries are not limited to a three-month permit. Their permits are issued free of charge and they may apply for the conversion of their home callsign to a South African cailsign if they intend to stay permanently or semi-permanently in South Africa.

Any person, regardless of nationality, may sit for the multiple choice RAE exam in South Africa. In fact the Wits Central Repeater covering the greater Johannesburg area is typical for the cosmopolitan nature of amateur radio in South Africa. While QSOs are predominantly in English and Afrikaans, callers in German, Portuguese and Hebrew are very likely to get an instant answer even late at night.

Portuguese nationals living in South Africa may sit for the RAE in South Africa in their own language and obtain a certificate by their own administration in Portugal. Such license may by used to apply for a callsign in South Africa, easing the language problem for the many Portuguese speakers.

The IARU Region I band plan applies in South Africa and visitors should use the two-meter band from 144,000 MHz to 145,999 MHz only. The 220-MHz band is not available for the amateur radio service in South Africa.

Further information may be obtained by writing to the SARL at PO Box 3911, Cape Town 8000, Republic of South Africa.

Lions in South Africa. The days of the lions roaming free in the country are a thing of the past, with mining, agriculture, and urbanization claiming their share. Today's Lions can be found regularly teaming up with radio amateurs for events like the "Hunting Lions in the Air," held every January. This year's will be on January 7th and l4th.

This event seems to be very popular in South Africa, looking at the results of the 1988 event. First place in the Club category (phone) went to ZS6TJ. This station is located in the Johannesburg Amateur Radio Center (Louis Botha Ave., corner Duff Rd. Houghton, Johannesburg). Second place went to ZS6TVL located right next to the world famous Kruger National Park where one can still find real lions!

In the Club category (CW) the first place went also to ZS6TJ in Johannesburg. In Cape Town the third place was retained by ZS1VP in the individual operator CW category. Overall participation was also very high with South Africa fielding the second largest number of stations in the world, with only the USA fielding more stations. Considering there are only just over 5000 radio amateurs licensed in the Republic, this is no mean feat.

With many rare club and event stations scheduled to participate in this event again, this could be your opportunity to get a rare QSL card.

The Dias Award. The Bartolomeu Dias Award is a unique award issued to commemorate 500 years of some of the most important sea voyages which demanded a complete revision of geography and led to a new phase in the life of humanity.

The voyage of Bartolomeu Dias when he arrived in the Indian Ocean with his caravels in 1488 stands out above all others. It allowed for the encounter of civilizations until then unknown to each other and led to great consequences in science, culture, economics, politics, and demography.

Issued in cooperation between the Johannesburg Branch of SARL and the National Amateur Radio Society Portugal (REP), the award is a further step to increase the good relations of South African and Portuguese radio amateurs and their friends in the world.

To qualify, 5 contacts with South African (ZS/ZR) stations and 5 contacts with stations in Portugal (CT) in the period January I, 1988 to June 1989 are required by stations other than those two countries. Applications must be submitted not later then December 31, 1990. All bands; CW, RTTY, and phone. Also available to SWLs. QSLs not required. Applicants should submit certified logs with 10 IRCs or US$5 to the Awards Manager SARL Johannesburg, PO Box 2327, Johannesburg 2000, Republic of South Africa.

[Packet radio report in a future issue.—CCC]

SOUTH AFRICA FIRST COUNTRY TO ACCEPT 73 UNIVERSAL APPLICATION

Peter ZS6ET writes: "If you intend to visit South Africa, address your application for an amateur radio permit to **The Department of Telecommunications, Private Bag X74, Pretoria 0001, Republic of South Africa.** The Universal Permit Application published in '73 International' [*see October's issue, page 88*] offers more information than required and should suffice." Peter's statement is based on information from the Department, but this is not an official approval, of course; that will not be sought until the form is further revised, based on comments and criticisms from around the world over the next two or three months.

WEST SIBERIA DX CLUB BEGINS SWDXC AWARDS PROGRAM

Gennady Kolmakov UA9MA, our Russian Hambassador, writes that "We have founded one of the first DX clubs in the USSR... with UA9MC as president... and UA9MD, secretary." UA9MA is vice president, and he sends us the following.

1. AOA (Arctic Ocean Award)— Details next month. **2. WAWS (Worked All West Siberia)**—Work following oblasts: 099, 100, 130, 145, 146, 158, 161, 162, 163. Class 1—40 QSOs in 9 oblasts, Class 2—30 and 8, Class 3—20 and 7.

3. U-PX-A (USSR Prefix Award)—Class 1—200 prefixes, Class 2—150, Class 3—100, Class 4—50.

4. U-1,000,000-C (USSR million-population Cities)— Work: Alma-Atu, Baku, Cheliabinsk, Dniepropetrovsk, Donetsk, Gorky, Kharkov, Minsk, Moscow, Novosibirsk. **5. PX-9-A (Prefix 9 Award)**—Work stations with figure 9 in their prefixes. Class 1—50 prefixes from 20 countries on 6 continents, Class 2—40 from 15 on 4, Class 3—30 from 10 on 3.

6. WSA (West Siberia Award)—Work stations from Zone 17 (WAZ) with the last cailsign letters from which spell the title of the award. For example: UA9AW, UL7CE, UA9MS, UH8BT, and so on for all 16 letters.

All contacts (or SWLs) must be made after January 1, 1980. No QSLs; send certified list to Serge **F.** Kruglov **UA9MC, PO Box 836, 644099 Omsk, USSR.**

"Rules for WSDXC membership: 1) 100 awards and certificates, including 'R-150-S' (or DXCC with 150 countries) and 3 ones from WSDXC, or; 2) 200 countries (R-150-S or DXCC with 200 countries) and 3 awards from the WSDXC. The entering fee is 20 IRCs. All applications must be signatured by 2 licensed amateurs."

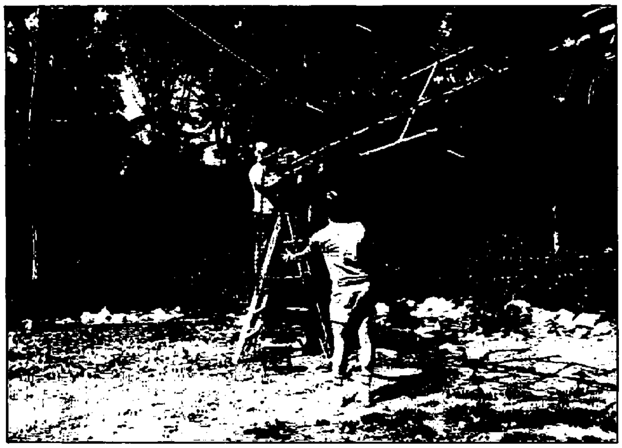


Photo B. Reinstalling the "phoenix" 2304 array. It worked well enough to bag five grids.

FN55, 64, 74, and even FN48, a grid located in a very remote section of Quebec, far north of Quebec City. The 2 meter station worked most of these same grids and bagged a fairly rare one in EM77 in central Kentucky. Our new operators couldn't have had a better introduction to the wacky world of VHF contesting!

After The Battle...

After the dust cleared, we wound up with about 550 QSOs and more than 165 grid squares, 51 of which were on 2 meters alone. And I've heard about even higher 2 meter totals from the Midwest, pushing well over 80. The best part was being able to knock all the stations down and leave for home just thirty minutes after the contest ended. Now that our new operators have survived basic training, maybe we'll give it a go again this January.

Mid-Atlantic Conference

The Mt. Airy VHF Radio Club, better known as the Pack Rats, just wrapped up another successful doubleheader weekend with the 12th Mid-Atlantic VHF Conference and Hamfest. They offered a good dose of technical presentations, an expansive flea market, and lots of fun. This was the first year I attended the banquet, and I managed to make a few of the seminars, which covered a variety of topics. Among them were: Propagation Enhancement Indicators, 6 meter Contest Arrays, VHF/UHF QRP Contesting, Water Cooling UHF Power Amplifiers, and Home-brew Microwave Dish Feeds.

About 100 people attended the banquet, and some great door prizes were awarded. Coaxial Dynamics graciously donated a wattmeter that I reviewed for *73*, and Avantek Corporation came up with several MMICs, bipolar, and GaAsFET devices, along with application sheets and PC boards. The evening concluded with a showing of the SCORE 1987 FM27 multi-projector show, after which all hands were off to the hospitality suite to talk shop while watching the Olympics.

Sunday brought overcast skies, that eventually cleared for a perfect sunny day. I brought some items to the flea market, many of which sold very quickly. There was more of a buying frenzy this year than last year (probably because it rained in 1987), and there were many good deals on antennas, coax, amplifiers, preamps, and just about any parts you can think of. If you live within a few hundred miles of Bucks County, try to make it in 1989. There's plenty of motel space for overnight stays, and it's fun to meet many of the faces that go with the familiar callsigns.

Project Time

From time to time, I will mention sources for microwave parts in this column. One of those sources is Steve Kostro N2CEI, who was selling at the Pack Rats flea market, and who has a nifty line of "roll your own" preamplifiers for 50 through 2304 MHz. I had already picked up a 903 MHz version and added a 1296 kit for good measure, with the idea of putting up mast-mounted preamps. Since I already had a pair of Dow-Key 260 relays in the parts box, it seemed like the thing to do.

The preamps sell for just $35 and include a Bud minibox, etched PC board, and all parts, including a NEC 720 series GaAsFET (typically a 72089 device). Steve claims a noise figure of better than 1 dB for these kits when properly tuned, and they are small enough to tuck away just about anywhere. They look like good weekend projects, and I'll let you know next month how they work.

> *". . . we wound up with about 550 QSOs and more than 165 grid squares, 51 of which were on 2 meters alone."*

Nice Tip

Incidentally, just how do you set up a preamp for lowest noise figure without a Noise Figure Meter? Well, it's easy if you have a weak signal source (such as a beacon), and you can switch to FM mode on your transverter/receiver combination or multimode. Then you just tune for best quieting. I tried this with a 432 and 220 preamp, and it works quite well, as the trimmer setting is not quite at maximum gain. Conversely, adjusting for maximum gain did degrade the signal-to-noise ratio somewhat. Thanks to W1VD for this tip.

Maximum quieting can be measured with a standard VTVM or FETVOM, using the AC scale and taking a signal from the quad detector or ratio detector. You can even take it from the speaker output, if necessary. It's not hi-tech, but it's a lot cheaper than purchasing an NF meter.

Once that preamp is set right, you'll want to put it in a weatherproof enclosure, add a few relays, build a sequencer, and run extra coax up the tower—it's all part of going Above and Beyond!

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Ten Reviews!

For home:

Two great HF rigs
FAX converter
10m vertical

For the road:

600-Watt amp
10m whip

Portable:

High-power HT
Pocket SW receiver
. . . and more!

Home-brew:

Plug-in C-64 packet
80m transceiver
Auto CW IDer

02

Welcome, Newcomers!

Reviews

Have you seen the film *Moscow On The Hudson?* In it, Robin Williams plays a Russian emigre who ends up in New York City. Soon after arriving in America, he goes to a supermarket and timidly pokes around. Having come from a land where even the staples aren't always available, the selection of food boggles him. **Front-end overload** sets in by the time he gets to the coffee section. He reaches for a package, knocks over a few other products—and passes out cold!

Drama aside, the example should be clear: newcomers to amateur radio can be easily cowed by the wide selection of gear. In 1988 alone, ICOM, Kenwood, and Yaesu presented nearly twenty new **transceivers**. In the past year, well over a hundred amateur radio products entered the market. It's as challenging now to shop wisely as it is to **home-brew** equipment.

Enter *73*

73 Magazine's answer to this is simple—a more aggressive product review program. We aim to run at least six reviews per issue, up from the average of two or three. We also plan a special review issue every year, which will feature product reviews of at least ten of the more popular items on the market.

Your feedback—what else?—prompted us to take this step. This demand was second only to "more home-brew." This still doesn't cover it all, of course, but it's a much-needed step in the right direction.

Our reviews are geared more for the operator than the tech purist. You won't have to wade through exhaustive, and exhausting, discussions of circuit particulars. Nor will you be distracted by graphs showing a transceiver's transmission **spectral purity.** If a **rig** meets **FCC** specs in this area—as virtually all modern rigs do—we just say so. We also don't take up valuable space with complete comparative listings of the manufacturer's specifications versus observed specifications. Most discrepancies are minor and can be effectively covered in a sentence or two.

Relevance

73 reviews focus on the practical issues: Whom would the product interest the most?—**DXers**, **digital mode** enthusiasts, or the Saturday-afternoon **rag-chewer?** How difficult was it to put the product together and get it up and running?—Is it entry-level or not? Is a piece of gear with operator controls **ergonomically** well-designed? Does the product perform according to the manufacturer's claims? Are the instructions clearly written, or clearly translated? Do they include plenty of graphics? How supportive is customer support? How does the piece of gear compare with similar products? How adaptable is it to other uses?

Last but not least: Where is there room for improvement? I think you'll find our reviews don't spare constructive criticism. The manufacturers respect this. They know they need your feedback in order to continue improving their line. They can no more afford to live in an ivory tower than we here at *73*.

Good luck!

...de NSIB

Are You a Potential Reviewer?

If this is something that interests you, send for our reviewer profile form. In it, we ask you to rate our review policy, and to tell us a bit about yourself as a ham, such as your favorite modes and bands, your station setup, and what writing, if any, you have done. When you receive it, just fill it out and send it back to us. You can also find this form on Compuserve's Hamnet. Feel free, also, to leave us a message on CompuServe (CS 73170,775), MCI Mail, (WGEPUB), or GEnie (BHASTINGS.3). Looking forward to hearing from you!

GLOSSARY

Amplifier—A device that increases the magnitude of a signal, usually with minimum affect on the signal's waveform.

Digital mode—A radio wave onto which information has been imposed with discrete states or levels, rather than with a continuously variable range. Morse code is a digital mode since all of the information it conveys is represented by only three units ("dits," "dahs," and spaces).

DXer—A ham who specializes in making long-distance contacts.

Ergonomics—Refers to the interfacing of an operator to a piece of equipment. An ergonomically well-designed piece of gear has controls that are sensibly and conveniently placed.

FCC—Federal Communications Commission. This is the government agency that regulates the allocation and use of radio frequency spectrum in the US.

Front-end—This refers to the amplification stage of a receiver that meets the incoming wave energy from the antenna system. Too much wave energy can cause the front-end to overload, causing wave distortion and blockage, and the production of unwanted wave products.

Hand-held—A transceiver that can be held and operated in the user's hand.

HF—High Frequency. This is a part of the radio frequency spectrum in which most worldwide amateur communications take place.

Home-brew—Home-built.

Rag-chewer—An amateur who enjoys conversing at length on the air.

Rig—A piece of amateur radio equipment, usually a transceiver.

Spectral purity— Refers to the spectral map of all the wave energy emitted in a transmission. The greater the proportion of total energy contained in the signal in the principal (fundamental) transmitted frequency, the greater the spectral purity.

Transceiver—A piece of radio equipment in which the receiver and transmitter are contained in the same chassis.

QRM

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Contract: Good—you're clearly following the advice to "always read the fine print." By the time you finish this sentence, you will have entered into a contractual agreement with *73 Magazine*. The terms are as follows: You have until the end of the winter to become someone's Elmer. You must wield a soldering iron at least two nights per month. You are to go to 28.3–28.5 MHz and have enthusiastic QSOs with no fewer than 4 Novices per week. And, last but not least, you must let us know how we are doing here through any number of media—by phone, letter, E-mail, or the feedback cards found in the magazine. You will be glad you read the fine print.

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FEBRUARY 1989 Issue # 341

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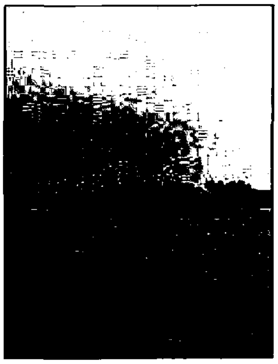
FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.



Photography by Suzanne Torsheya

Number 2 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

The Military Will Save Us!

Welcome again to the Green Gloom Guide wherein I blow another Pollyanna ham shibboleth out of the water—to mix my metaphors. I sure wish my gloom bulletins would stop proving right.

In the past, one justification for a tiny group like ours (amateurs) to hold on to such an enormous number of incredibly valuable and desperately needed radio frequencies was that in time of war these would become an irreplaceable military resource. This was, when originally planned, an excellent idea.

Within hours of our entering WWII, our ham bands were closed and turned over to the military. I was there, operating on 160m, that fateful December 7th, 1941. In fact, it was a W8 in Stacy Basin, NY, who told me first about the attack on Pearl Harbor. Little did I realize that a few months later I'd be on my way to the Pacific to fight Japan from a submarine.

I wasn't around for WWI, so I don't know what they did with the ham bands then, but I do know that many of them were used by the military in WWII. My SD radar used the old 2½ meter ham band—112–116 MHz. It had an antenna on a periscope mast which I could stick out of the water while we were submerged to check for planes before we surfaced. It didn't take long before the Japanese equipped their planes with 112 MHz receivers and used the SD signals as beacons. By late 1943 we'd pretty much stopped using this magical aircraft magnet. The newer 3 GHz SJ radar was higher than the Japanese could build receivers at the time, so we used that instead. I never saw any sign that the Japanese could pick up the SJ radar at any time during 1944 and right up until the end of the war in 1945. Using this radar I was able to guide my submarine on the surface at night right down through the middle of Japanese troop convoys. No, they definitely couldn't tune 3 GHz then.

In past decades when the FCC has rattled their sabre, threatening to lop off part of a ham band, the military has been right there protecting our (their) frequencies. That support helped many times.

So where's the cavalry now, when 40% of our 220 band is being chopped off? There's a curious silence from the Pentagon. Well, not so curious, if you really think about how technology has changed since WWII. You have noticed some changes, right? Well, maybe not in the ham bands, but if you have been keeping up with the technical journals you're aware of how many light-years we hams are behind the cutting edge of communications technology. Up until the League's blessed Incentive Licensing disaster 25 years ago we were up front.

Times are a 'Changin'

Frankly, I don't think we're going to get much support from the military anymore—and I'll tell you why. First, when we entered WWI and WWII our country had a couple of years leeway to get its act together. We needed it. The radio equipment we were making for the military in 1941 had largely been frozen in design in 1935 and was virtually antique while it was being churned out by the zillions.

Green's exaggerating again, right? In the summer of 1942 I worked as an electronic technician in Building 89 at the GE plant in Schenectady. We were building the BC-191 and BC-375 transmitters. They were identical except for power voltage. They were enormous kluges. The Army used them in staff cars and as portable transmitters. They were eventually superseded by the SCR-274N Command Set rigs which were about 1/10th the size and far more stable.

Lacking frequency synthesizers, one needed a frequency standard to find a particular frequency. When I first reported on my

Continued on p. 8

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, 70 Rte. 202 N., Peterborough NH 03458, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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Never Say Die

Continued from p. 6

submarine, two of my communications receivers were still old regenerative jobs from the early 30s. . .the old RAX-7 and RAL-7. The LR1 frequency standard on my sub had 90 tubes and weighed in at nearly a hundred pounds. We used that until the end of the war.

To keep communications confidential we used a special typewriter-like device, the ECM, which encrypted and decrypted messages automatically. It was invented by the Germans. Today that's all done by computer and built right into most equipment.

Today's military communications equipment has to be made so any idiot can use it. This means as little tuning as possible. . .and that means fixed, standard channels. Even the military have discovered that no system is going to work in an emergency if it isn't working on an every-day basis. The bottom line is that today's military equipment is designed to work on today's military frequencies, not on our ham bands. And it doesn't seem to fit many wargame scenarios for the military to plan on having two years to train new technicians and build a whole new type of equipment which might make our bands of some value to them.

There are two basic war potentials the military have to plan for. One is a nuclear attack, in which case we essentially have no real plans. The other is a repeat of limited wars such as we fought in Korea and Viet Nam. We haven't much stomach for those "little" wars, so they're unlikely.

Little wars would be fought with what's being used at the time. It's unlikely that if we got sucked into a war in Iraq or Sri Lanka that we hams would be put off the air or that our military would do anything more than place some big radio contracts with Japan or Korea.

Our ham bands seem to be largely obsolete as a military resource. Technology has passed us by there, too. No, if we're going to try and hold on to our bands we've got to face the responsibility involved and stop lying to ourselves. We've got to show that we're worth a national investment of hundreds of billions of dollars in what are now almost totally unused microwave ham frequencies.

I wasn't exaggerating when I humorously wrote about selling our bands and pocketing the money. Of course, they're not ours to sell, but if they were, the relatively few hams who are using the 220–222 MHz part of the band could easily pocket several million dollars apiece.

In the recent past we've seen the loss of 80 MHz on the 2300 band, 25 MHz on the 1200 band, the top half of 160 is going, 10 MHz on line A from the 420 band, and now 40% of the 220 band. Whew, tell me when you think I'm right and that we should start to do something. That "we" means YOU and not some vague other group.

our bands. You can get your city or town to make substantial improvements in education. You can motivate your own kids or grandchildren to excel. You can get your state to make some desperately needed changes in education. You can even be a big factor in getting the federal government to make needed changes. I'm not exaggerating—when you know how to do these things and make up your mind to get them done, nothing can stop you.

For instance, we're in the process of losing 40% of the 220 band. We all know that once we

"Our ham bands seem to be largely obsolete as a military resource. Technology has passed us by there, too."

Building Support

Using amateur radio and an understanding of the real power conduits in America, we have the potential for affecting the entire world. We all know that technology is the future—we see that at every turn. Few jobs in America today don't involve computers. Most involve the telephone, facsimile, and information. Any country which falls behind in technology is going to be a poorer country. Look at the power television and the print media have over the whole world!

I brought my message on solving America's problems to the people of New Hampshire and they responded with a solid vote for me as Veep. Thank heavens Bush didn't take this seriously. The Veep job is terrible—not one I'd ever want. I believe I can get more done where I am than I could sitting in Quayle's office. Well, with your help I can.

How can we get more *73* subscribers? With your help and support we can get your ham club members to subscribe. You can run *73* subscription booths at hamfests and conventions. You can give gift subscriptions to your friends and get them aboard. With less than 100,000 subscribers, I'm not going to be able to be very effective.

You know, it's absolutely amazing what you can get done when you decide to do something. You can stop smoking. You can lose that weight you need to. You can stop the FCC from taking away lose a band that's the end—we're never going to get a chance to get it back. Amateurs in the past have either allowed us to lose bands or have actually been paid off to let them go—and there's a lot of evidence that we were sold down the river by some former trusted ham officials.

Just in my ham memory we've lost much of the 1815–2050 kHz band, allowed short-wave broadcasting to take most of our 40m band, and lost 14350–14400 kHz and 29.7 to 30.0 MHz. Just before I got active in hamming we'd lost 7.3 to 8.0 MHz and 14.4 to 15.0 MHz. We've gained some little slivers from WARC—and the 15m band, so it hasn't been all downhill.

We've recently been given a 900 MHz band, but lacking anyone to use it, the likelihood is that it'll be blown away before we ever get around to doing anything about it.

The FCC says we have about 400,000 licensed hams. Surveys indicate that at best only half of these are even remotely active or read any ham magazine. That gives us a total pool of perhaps 200,000. Can we get half of the "active" hams to read *73* so we can start moving the world? You tell me. Start asking your friends and see what it's going to take. I'll make *73* any way you want it that you think will work. I can't make it both more technical and simpler. I can't be both pro and anti-ARRL. By the way, I give the FCC a bad time when I think they are doing wrong. I do the same for the ARRL. I'm not anti-FCC or anti-ARRL. That's a silly simplification with no basis in reality.

A New League?

I was approached by a ham industry chap the other day who is starting a new national ham organization and wanted my help. Just what we need, another way to split the hobby wide open. He and another manufacturer seem to feel that there is enough frustration with the ARRL that they can build a new national club. There's nothing wrong with the ARRL that replacing those old traffic men directors who are running it won't cure. We don't need a new national organization. And we particularly don't need one controlled by two ham industry people who have a lot to gain personally. The good old greed factor, I suspect.

If you can help me get 100,000 subscribers (and that's less than *QST* has), I'll give you the biggest ham magazine every month and together we'll change America and then the world. I've got the lever, I just need you to help me push it. Are you with me?

Veeping

Okay, you've got Dan Quayle as the vice president. I heard the other day that the real reason Bush chose Quayle was as an insurance policy to make absolutely sure he doesn't get assassinated. I suspect he's made his Secret Service bodyguards obsolete. Clever move.

Last year, on my 65th birthday, I announced for the vice presidency in the New Hampshire primary election. I'd done this on a lark in 1964 and found that I got a good deal of attention. The attention was amusing in 1964, but I had no practical use for it.

This time I had what I thought was a powerful message—one about getting America back to #1 in the world, with one of the key elements being a rebirth of amateur radio as a way to get millions of youngsters really interested in technology.

My running for the vice presidency was tongue-in-cheek, as I made clear. But my message was serious. Unlike the presidential candidates, I had some proposals for solving the many problems facing our country—problems we must solve if America is going to regain its world technological and financial strength.

I've written about these ideas in my past editorials. Many of the

Continued on p. 65

QRX . . .

EDITED BY BRYAN HASTINGS NS1B

Mir Miru = Peace To The World

Did you know that the Russian word *mir* means both "peace" and "world"? it seems an apt name for a space station that orbits the globe for the peaceful intent of space exploration and colonization. International amateur radio contacts between the cosmonauts and terrestrial stations adds to the peaceful pursuits of *Mir*.

The three cosmonauts on *Mir* since the fall of 1988—Vladimir Titov, Musa Maranov, and Vladimir Polyakov—all have callsigns and operating privileges on the ham bands. Their calls are U1MIR, U2MIR, and U3MIR, respectively. They operate 2 meter FM, using a Yaesu FT-290, and a ¼-wave whip mounted outside on one of the craft modules. You are most likely to hear them on the air between 0500–1000 GMT, and on any frequency between 145.4–145.6 MHz. They are often on 145.55 MHz simplex, and on duplex with the uplink frequencies 20–30 MHz on either side of 145.55.

Those who have worked *Mir* can QSL direct to: B. Stepanov UW3AX, PO Box 679, Moscow 107207 USSR.

Satellite Blow-out Issue!

Andy MacAllister WA5ZIB, our "Hamsats" columnist, has decided to take on the job of coordinating the May 1989 Super Satellite issue. He will amass all the hamsat-related articles for this issue.

We are fortunate that Andy has taken on this task, as he is ideally suited for it. Andy sits on the Board of Directors for AMSAT-NA, North America's premier organization devoted to hamsat activity. This is going to be a blow-out issue, with 45–50 pages of hamsat-related articles, from home-brewing to contesting to tutorials. Any readers interested in contributing to this issue should contact Andy at: 14714 Knightsway Drive, Houston TX 77083. Make sure to get all editorial materials to him by 15 February!

Changing of the Guard

Pete Putman KT2B, our "Above and Beyond" columnist of 3-½ years, is taking a hiatus from amateur radio. His last column appears in this issue. We are sorry to see him go, as he was one of our most prolific writers, and his column was very popular. Yet we understand—now he's focusing on family and the development his A/V presentation business!

Chuck Houghton WB6IGP, a guru on microwave operations, is the new "Above and Beyond" columnist. His column will debut in March. He has written a number of articles for amateur radio journals, focusing on microwave home-brew. He has been a microwave technician for Pacific Bell for 24 years, and has worked extensively on both analog and digital systems in the 2–12 GHz range. He is no stranger to VHF and UHF, having extensively worked on 150 MHz services and 450 MHz mobile radio systems. Chuck is also very active in the San Diego Microwave Group.

Chuck welcomes any microwave-related questions from the readership. His address is: 6345 Badger Lake, San Diego CA 92119.

Oops

There is a small correction to the ICOM 32AT dual-band handheld review that appears on page 68 of the December 1988 issue. The HS-10 headset does, in fact, work with this HT.

Weather Satellite Handbook

73 Editorial still receives many calls from people relating to Ralph Taggart's *Weather Satellite Handbook*. Ralph, for the time being, is not an Associate Editor with the magazine. Questions about his book should go directty to him at: 602 S. Jefferson, Mason MI 48854.

License Figures

Novice Enhancement should be renamed Technician Enhancement, based on FCC licensing statistics recently released. They show that the Technician class license is the fastest growing of any class in the history of the U.S. Amateur Service. The specific growth figures for October 1, 1987 through September 30, 1988 are:

Technician	+8.70%
Extra	+6.80%
Advanced	+0.21%
General	−1.26%
Novice	−3.68%

This provides for an overall growth in the amateur service of 1.54% in the past 12 months.

For the second consecutive year, this second level of the amateur radio licensing ladder shows the greatest growth. If this trend continues for the next several years, Techs may well be the most populous class of license.

CW Washed Up?

Emergency and distress messages sent using Morse code and human operators will be gone from the high-seas by 1993! This is the decision of the International Maritime Organization—a United Nations agency for safety of shipping and prevention of pollution by ships on the seas. The traditional "SOS" sent by Morse code is being replaced by the new and highly sophisticated Global Maritime Distress and Safety System which transmits and receives messages automatically. The computer-based communications system uses satellite intertie. With the new system, any person need only push a single button to send a worldwide message that contains all data needed to affect rescue.

In addition to the main GMDS system, ships will carry self-powered radio beacon transmitters designed to float freely and transmit an exact position in case a ship sinks without warning. A spokesman for the International Maritime Organization says that as soon as the new system is operational, shipboard radio operators and their gear will be phased out.

The decision to completely abandon Morse code as a maritime communication tool is bound to have repercussions in other services, including amateur radio. One of the many services hams have prided themselves on is the interception and accurate relay of maritime distress messages to the Navy, Coast Guard, and other rescue agencies. The move to this high-tech maritime rescue system will give more leverage to the growing number of voices calling for the abolition of CW as a requirement in obtaining an amateur license. With growing evidence of the failure of Novice Enhancement, the current mood in United States amateur radio political circles seems to be toward some form of entry-level code-free license.

TVRO

A US District Court in New Jersey overturned a restrictive home satellite dish zoning ordinance by the town of Maplewood that would have unreasonably impaired the Installation and use of home TVRO systems. In its decision, the court cited the 1986 FCC preemption that prohibits local municipalities from unfairly restricting home dish installation and use. The Maplewood ordinance restricted antenna height to six feet and placed land-

scaping, set-back, and other restrictions on the homeowner.

Gateways Needed For AO-13

OSCAR gateways are needed for educational purposes. AMSAT-NA Science Education Advisor Rich Ensign N8IWJ is compiling a list of stations which can gateway OSCAR-10 and OSCAR-13 to local repeaters. Rich is especially interested in gateway stations willing to participate in school interchanges via satellite. If you have a gateway station and wish to participate, please call or write to Rich Ensign. You can reach him by phone at (313) 274-1718 or by mail at 421 N. Military Dr., Dearborn MI 48124. Those who wish a copy of the compiled list should send Rich an SASE. Both Mode B and Mode L Gateway stations are being sought. Gateways in all countries are welcomed and encouraged to participate.

Glasnost' Revisited

Leonid Labutin UA3CR may be the first Soviet in many years to get a United States amateur license. On Sunday, the day after the AMSAT 1988 Space Symposium, Leo became W4/UA3CR. He passed the United States Amateur Extra-Class exam given to him by Volunteer Examiners at Georgia Tech. Leo mentioned that his biggest problem was understanding all of the FCC regulations, but, after studying the night before, he had no problem passing all of the exam elements from Novice to Extra-Class.

Dayscholar

The Dayton Amateur Radio Association is now accepting applications for its Scholarship Program. The program is open to any licensed amateur graduating from high school in 1989. Awards will be based on a combination of financial need and academic accomplishment. Consideration will be given for service to amateur radio and for community involvement.

There are no restrictions on the student's course of study, and applicants are not restricted to those preparing to pursue four-year Baccalaureate degrees. Those working toward Associate degrees or planning to attend an accredited technical institution will also be given consideration.

Each winner will receive an award of $1000 toward their tuition at the school of their choice. Entries must be postmarked before May 15, 1989. Winners will be announced on or about June 1st.

For further information or applications, write to the Dayton Scholarship Committee, 317 Ernst Avenue, Dayton OH 45401.

Thanks

. . . to all those who contributed news items to this month's QRX column. They are: *Westlink*, UB5UN, AMSAT-NA, Associated Press, WD9HXH, ARRL. Keep sending your news items into 73 Magazine, WGE Center, 70 Rte 202 N, Peterborough, NH 03458-1194.

Double Trouble! Seated are Joanne Gustafson KB9BMD (forward) and Jennifer Gustafson KB9BHR, both of Orion, Illinois. These 16-year-old twins are seated at the station of their grandparents, Leslie Conrad NO9X and Mary Conrad KA9WAG. Their Elmer was Bob Ward KØSZV.

73 Review

by Brian Lloyd WB6RQN

Kenwood TS-940S

A top-flight HF rig.

Kenwood USA Corp.
PO Box 22745
Long Beach, CA 90801-5745
(213) 639-4200
Price Class: $2270 w/o tuner
$2500 w/tuner

The Kenwood TS-940S.

A Substantial Impression

The TS-940S is a full-featured HF transceiver that provides AM/FM/FSK/SSB/CW operation for all amateur bands from 160 to 10 meters. General receiver coverage ranges from 30 kHz to 30 MHz, with all-mode transmitter operation on all HF amateur bands. The radio is completely standard with no options other than the built-in automatic antenna tuner.

My immediate impression, as I placed the radio in operating position, was "This radio is substantial!" If mass is any indication, this is one robust piece of gear. Unless you are Arnold Schwartzenegger, you are not likely to consider this to be a portable rig. On the other hand, you are likely to believe Kenwood's claim that this radio has a 100% duty cycle for continuous carrier modes like RTTY and SSTV.

There is another reason why you will not run this rig in portable operation. The PA runs on 28 volts. This reduces collector current and results in a more linear and efficient PA. Unfortunately, it also makes the radio a bit difficult to power from your average 12 volt automotive electrical system. Plan to have a 120/240 volt AC power supply on hand when using this radio.

First Evaluation

My first evaluation was for ease-of-use. I set up the transceiver and deliberately ignored the manual. I wanted to see how intuitive the operation of the TS-940 really is. Although the panel is more complex than what I am used to (my last rig was a Collins KWM-2 which I regret having sold), it seems well laid out. The functions of most of the controls are obvious. As a result, I was able to have the receiver operating within a few seconds of turning it on. Unfortunately, Kenwood does not supply a microphone, so I could not get on the air immediately.

At the Controls

None of the switches or dials are "overloaded," i.e., none have more than one function per control, with the exception of the band select/data entry/memory select keys (more on this later). The controls are well-placed with room for your fingers and sufficient spacing between controls to prevent you from accidentally activating two controls simultaneously. Everything is immediately accessible, including the infrequently used controls beneath the sliding metal panel on the top of the rig.

To select operating mode, you press the appropriate mode button to the left of the main tuning knob. The radio then sends the character associated with the new mode to you in Morse code, e.g., "L" for lower sideband, "U" for upper sideband, "A" for AM, "C" for CW, "F" for FM, and "R" for RTTY. The audible feedback is nice if, like me, you like to occasionally operate late at night with most of the lights turned out.

Operating frequency can be selected in one of two ways: you can grab the main tuning knob and turn until you have reached the desired frequency, or you can press the ENTER button and key the desired frequency directly. To speed frequency selection using the main tuning knob, you can either use the MHz UP/DOWN buttons to get within 500 kHz of the frequency, or you can press one of the band selection buttons to place you within one of the ham bands from 160 meters to 10 meters. All WARC bands are represented and the transceiver will transmit on all of them. I tried transmitting outside of the ham bands (into a dummy load, of course) without success.

The tuning rate is a function of the operating mode. SSB, CW, and FSK use a tuning rate of 10 Hz/step. The tuning rate for AM and FM is 100 Hz/step. This can be a bit cumbersome since there is no way to increase the tuning rate of the main tuning dial. If you wish to move rapidly from one end of a band to the other you must either enter the frequency directly or you must turn the main tuning dial many times.

Memory and Display Features

The keypad for direct frequency entry is used for memory selection, frequency selection, and band selection. It is unlike either a telephone or a calculator keypad, so you have to think about what you are doing. Using it takes some getting used to.

The TS-940S has 40 memories, but only 10 may be accessed from the front panel at any one time.

Another "feature" of the memory capability is the inability to tune the memory once it has been selected. You have two options: use the receiver incremental tune (RIT) or copy the frequency from the memory to one of the VFOs. I found both approaches to be quite satisfactory.

The frequency display itself is quite clear and will display frequency with 10 Hz resolution (you can switch it to 100 Hz display resolution if you wish). The display always shows the carrier frequency for the appropriate mode. I was especially pleased that the space frequency is displayed when operating in RTTY (FSK) mode. There is no need to add or subtract the frequency of the modulating tones from the carrier frequency to determine the actual transmission frequency.

Across the bottom of the frequency display is an analog-like slide-rule display. When moving rapidly across the band, this display can give you an idea of where to stop. A switch on the top panel lets you select a range of 100 kHz or 1 MHz for this display. If you find digital displays to be annoying (I do for everything

BUT frequency) this may be an attractive feature.

Most Important Part of the Rig

Next, I examined the receiver. I consider the receiver to be the most important part of any rig, so I was especially interested in seeing how well this one would perform. You are allowed to select two different time constants for the AGC, fast and slow, or you can disable the AGC entirely and control gain by using the RF gain control. The AGC is very effective and "flat." There is almost no need to change the audio gain control even when you move from a very weak to a very strong signal. There is a four-position attenuator providing 0–30 dB of attenuation in 10 dB steps. At no time did I find the attenuator necessary to prevent front-end overload.

There are two fully adjustable noise blankers in the TS-940S. One seems to work very well for the over-the-horizon backscatter radar (woodpecker) and the other seems to work best on short duration pulse noise (ignition noise). Just turn on the appropriate noise blanker, then slowly increase the blanker level until the QRN disappears. There does seem to be a slight interaction between the noise blanker and nearby strong signals, but judicious use of the blanker level seems to keep this problem to a minimum.

Perhaps the most important feature of the receiver is its continuously variable IF bandwidth. In SSB mode, the lower and upper filter skirts are independently movable, providing "low-cut" and "high-cut" operation. In CW and RTTY mode, there is a single knob to vary the width of the passband. In CW you can also vary the BFO injection frequency, thus allowing you to pick your favorite CW note while still keeping the signal in the center of the IF passband.

On the surface this selectivity scheme seems just about ideal. In some cases it can be useful in reducing adjacent channel QRM. But, I don't think that the skirts of the standard filters are sufficiently steep to make this really useful. As you move away from full bandwidth, you don't have the second and third IF filters working in unison. The resulting roll-off at the edge of the passband is not as sharp as I would like. On the other hand, it does work and it is far more flexible than almost any other rig that I have used. I think that the optional filters would improve things considerably.

In order to help you visualize the passband, Kenwood has provided a multi-function liquid-crystal display that serves to display memory frequency content, time, and IF bandwidth. The display shows a single vertical line that represents the center of the passband. Below this line is a bar that shrinks as you reduce the width of the passband in CW or RTTY mode, or shrinks from the left or right when you use the low-cut or high-cut controls with SSB. This display is quite useful for showing memory content or time, but as a tool for setting up the receiver's passband it is almost useless. The problem is twofold: there is no calibration, so you have no idea what the width really is; and there is no indication of where the BFO injection is, relative to the passband. I found the markings on the knobs and my own ear to be just as useful in determining bandwidth. Maybe future versions of the TS-940 will have a more useful presentation.

CW, FSK, and RTTY on the TS-940S

In SSB operation I found the receiver to be a good performer, although I don't think that it is significantly better than other rigs that I have used. Where this rig shines is in working CW. You can really pull out the weak ones. Here is the technique I used:

Tune in a signal and get it approximately in the center of the passband. Use the notch filter to eliminate any especially offensive signal. Begin reducing the bandwidth while carefully tuning to keep the signal in the center of the passband. Last, use the tunable audio bandpass filter to peak the desired signal.

Using this technique I was able to isolate almost any signal. It makes copying even very weak signals a breeze. With the quality of the receiver and the full break-in (QSK) transmitter, I can easily see this rig becoming the CW contesters' favorite.

Using the TS-940S for copying RTTY, I was again quite impressed. The CW bandwidth control is operational for RTTY, allowing the operator to adjust the bandwidth to pass the desired signal, but to reject QRM regardless of the shift being used by the sending station.

There is one minor drawback with the FSK mode of operation on the TS-940S. The pitch control does not function. It would be nice if the pitch of the two tones could be varied so that a wide range of modems or terminal units could be used. In some cases the modem or TU can be adjusted to accommodate the radio so that the lack of a pitch control when operating RTTY or packet is not a big problem. Still, it is a feature that could have been added with very little trouble since the control is already there. Perhaps Kenwood will come out with a modification that will allow this.

Testing and Transmitting

I did not do any testing of the rig with test equipment, but I did want to get a subjective impression of the phase noise on this rig compared to some other radios. Compared to a non-synthesized radio (a Collins KWM-2), the phase noise is evident but not overly objectionable. When I compared the TS-940S to a top-of-the-line rig from another manufacturer, I found the phase noise to be about the same.

The transmitter of the TS-940S is quite nice. Its 250 Watt PEP output is only 7 dB, or about one S-unit, down from the legal limit. I can't imagine too many people needing or wanting to run an outboard amplifier. If you need more "punch," you can turn on the fully adjustable speech processor.

The manual claims that the speech processor operates at RF to decrease the difference between peak and average levels as much as possible. In my on-the-air tests, it raised the average signal level considerably. Setting the speech processor levels too high can result in a signal that is offensive to some. Use it sparingly and only when you really need it.

Super Antenna Tuner

One of the best features of this transmitter is the optional automatic antenna tuner. Using this tuner is quite easy: select the operating frequency, press the AT.T button, and key the transmitter. The tuner will tune out any mismatch and inform you of the results on the LCD display. When the radio informed me that it had successfully matched the antenna, I was able to secure full power output. I can imagine getting into the habit of retuning the tuner whenever the band or antenna is changed to protect the PA from inadvertent damage. As far as I am concerned, this feature is an absolute must.

I was quite surprised at the range of the tuner. I tried several different commercial antennas and a random wire. The tuner was able to cope with all of the commercial antennas without any problems. The tuner did have difficulty with some lengths of random wire on some frequencies, but slightly changing the length of the wire solved that problem. If the tuner was unable to come up with an acceptable match, and this situation occurred very infrequently, the message "No match possible" appeared in the LCD display.

While on the air I got nothing but good reports from everyone I talked to. On CW no one could detect chirp, click, or other bad characteristics. I became addicted to the full break-in (QSK) operation. I did use the speech processor once or twice and everyone I talked to seemed to think that it added about 4 to 5 dB more punch to the signal. No complaints about this rig for CW or SSB operation.

Packet on the TS-940S?

I was hoping to use the FSK mode but, unfortunately, it cannot be used with packet because the FSK shift is not adjustable. Packet uses a 200 Hz shift. The TS-940S is synthesized at 170 Hz (actually a 165.9 Hz shift), but is strappable for 170, 425, or 850 Hz shifts internally. This is not documented in the manual, but it does appear in the schematic for the PLL unit.

There is no way to select the BFO injection frequency, either. Changing the BFO injection frequency would permit the operator to change the audio tones coming out of the receiver to allow compatibility with different modems (RTTY typically uses 2125 and 2295 Hz tones while packet uses 1600 and 1800 Hz tones). I was forced to fall back on the old standby of selecting LSB operation and using AFSK. Still, the continuously variable passband makes packet reception pretty reliable. You just have to do a little more work to figure out the operating frequency.

In Sum

Now we're down to the bottom line: this is a first-class radio. If you are into HF packet radio, you might be disappointed about not being able to make use of the RTTY mode of operation. It does, however, do what it was designed to do, and it does that very well. If you are looking for good performance, and you can ignore the slight ergonomic deficiencies, then this rig is for you. Thanks for a good effort, Kenwood. 73

FEEDBACK

In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers, which appear on each article/column and are also listed here. These numbers correspond to those on the feedback card opposite this page. On the card, please check the box which honestly represents your opinion of each article or column.

Do we really read the feedback cards? You bet! The results are tabulated each month, and the editors take a good, hard look at what you do and don't like. To show our appreciation, we draw one feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*.

To save on postage, why not fill out the Product Report card and the Feedback card and put them in an envelope? Toss in a damning or praising letter to the editor while you're at it. You can also enter your QSL in our QSL of the Month contest. All for the low, low price of 25 cents!

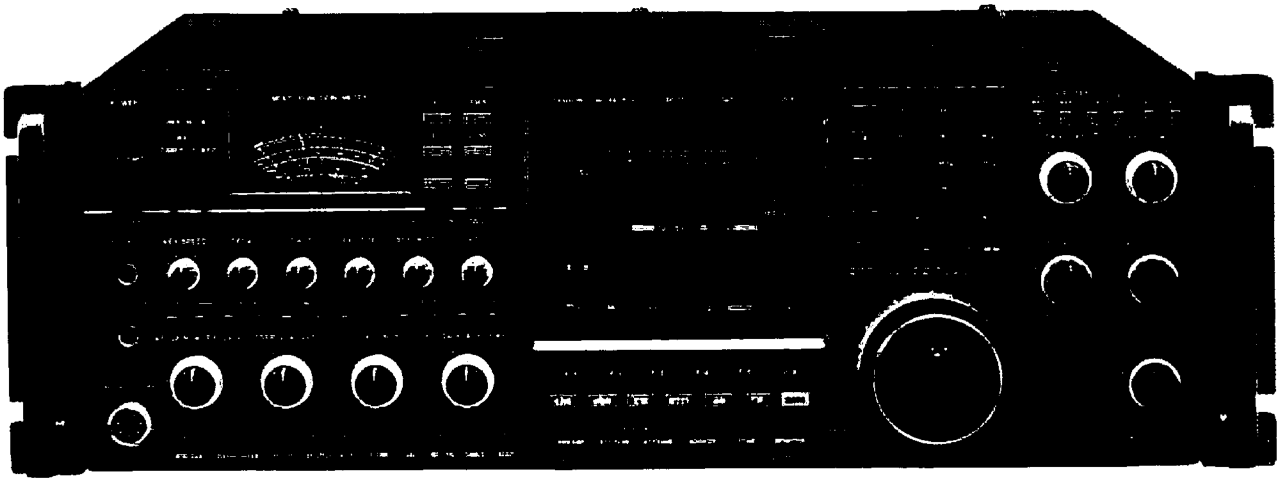
Feedback# Title

73 Review *by Bill Clarke WA4BLC*

The ICOM IC-781

Quintessential DX Rig

ICOM America, Inc.
2380-116th Ave. NE
Bellevue, WA 98004
Price Class: $6000



Last year I reviewed the ICOM 761 and stated that it was "the most precise and complete ham transceiver from ICOM to date." And it was, once upon a time; but now, the ICOM 781 is ICOM's latest and most complex HF transceiver. It is fully solid state and CPU-based. The mere term "transceiver" doesn't do it justice. The IC-781 incorporates features that used to require a desktop full of extra equipment.

The IC-781 combines a CRT display of functions, frequencies, memories, and spectrum scope with a top-notch transceiver, automatic antenna tuner, and AC power supply, into the most complete one-piece HF ham station available today.

The IC-781's Operating Manual

The first mark of the IC-781's high class is its operating manual. It is absolutely thorough—it has nearly 100 pages of instructions, photos, diagrams, and charts. The manual comes in a zippered, heavy-duty plastic bag, the kind meant for re-use, along with the radio's inspection certificate and warranty cards.

After unpacking the radio and placing it on my operating desk, I studied it for a few minutes. I counted 112 separate controls on the front panel, and decided that it would be greatly advisable to read the instruction manual before plugging it in.

Overview of Features

The built-in spectrum scope displays the relative signal strength of radio transmissions up and down the band from your frequency. The band width is selectable between 50, 100, and 200 kHz. It is not a true scope, but a well-engineered computer facsimile.

The Terminal Monitor allows you to use the CRT for digital display of RTTY, packet, etc., and the built-in Automatic Antenna Tuner is for hands-off adjustment of antenna matching (limited to 16.7–150Ω, or at less than 3:1SWR). The Direct Digital Synthesizer provides extremely fast "lock-up" times for transmit/receive switching.

Dual Watch lets you monitor two separate frequencies simultaneously, while Fine Scanning tunes slowly through a received signal without stopping. This feature is particularly valuable for CW and SSB. Twin Passband Tuning controls tandemly, or separately, the tuning of the 455 kHz and 9 MHz IFs.

The AGC is fully adjustable. During CW operation, the Audio Peak Filter attenuates unwanted audio components between 500 and 1000 Hz.

Other features are: full break-in keying, 150 Watt output, noise blanker, 105 dB dynamic range, and a multi-function keyboard for digital (fingertip) entry of frequencies. The memory channel holds 99 memories, including two-band scan entries. You can display these memories, together with a label, on the CRT. Examples of labels are net names or operator notes. The IC-781 has two clocks for local and UTC time settings, and timers for turning the transceiver on and off as predetermined.

This review is made from an operator's point of view; it is not the result of strenuous laboratory testing.

Operator Viewpoint

The IC-781 is quality all the way. The controls feel solid, everything works as expected, and the manual explains all you need to know, in both words and diagrams.

The tuning knob is large and has a fairly smooth action. It tunes at the rate of 5 kHz or 2.5 kHz per revolution, as selected by an internal switch. The knob is not as large or as smooth in operation as the IC-761's. The main tuning knob has a tension adjustment under the front of the radio.

The frequency read-out has the 10 Hz digit. I find this feature nice, although some operators feel that it makes tuning too critical. This is a matter of choice. You can calibrate frequency without entering the case.

Many of the seldom-used controls, such as VOX, lighting, etc., are pull-out types. The clocks and memories have battery backup. Should the batteries fail, the radio will continue to operate, without memories or clocks.

In general, the IC-781 performs as you would expect a top-of-the-line radio to perform. After learning how to use the many controls, I found it was possible to clean up signals unreadable on older types of radios. For example, signals in the QRM on a TR-4 became completely readable on the IC-781.

The speech processing gave an extra punch to the signal that reached out well, yet it did not foul up the intelligibility of the transmission. On a scope, the voice patterns filled in well when I used the processor.

The spectral display of the band revealed the location of the loud stations, and also indicated open places in the band. It afforded a quick look at a band for activity.

Being able to scroll the memory list on the CRT and to enter the frequency and mode with a single keystroke are great features of the IC-781. When dealing with 99 memories, I found the label field very important. It allows you to name a memory (i.e., MIDCARS, VA FONE NET, GULF COAST, etc.) and easily access it.

The IC-781 Receiver

The receiver is very quiet, with little background white noise. With fully variable parameters, it can reduce or eliminate most QRM/N. The twin passband tuning is especially effective in cutting out QRM from adjacent signals. Forty meter evening operation is relatively easy with the twin passband tuning, notch, and attenuators. The notch filter is easily tuned and effectively deep. However, considering the price of this rig, why isn't it automatic?

For more variables, you can use the receive preamp or the attenuators. You can choose 10 and 20 dB for the latter, or switch both on for 30 dB of attenuation.

The quality of the receive audio from the built-in speaker is excellent, coming in a close second to my main station speaker. The BASS/TREBLE controls improve the built-in speaker's sound quality.

The IC-781 has several methods of scanning. It does memory scan, programmed scan, and mode scan. To use mode scan, you must first go into memory mode. There, mode scan will find channels of only a given mode, e.g. LSB or FM.

Dual watch is nice when you're monitoring a specific frequency for activity. It does, however, have the drawback of being limited to the same band as other operations. There is no crossband dual watch.

The passband tuning arrangement looks like it would be great on RTTY and packet, although I didn't test this possibility.

The Transmitter

The two VFOs make split operation available at the push of a button. The IC-781 can also be easily modified for CAP and MARS frequencies.

ICOM 781 Specifications

General

Frequency Coverage:
Receive: 0.1 MHz to 30.0 MHz
Transmit: 1.8–2.0
3.4–4.1
6.9–7.5
9.9–10.5
13.9–14.5
17.9–18.5
20.9–21.5
24.4–25.1
27.9–30.0
Modes: SSB (A3J)/CW (A1)/FM (F3)/RTTY (F1)/AM (A3)
Frequency step: 10 Hz (TS off) 1 kHz (TS on)
Antenna Impedance: 50Ω unbalanced (tuner off)
Power requirements: 100–120 VAC (US version)
220–240 VAC (others)
Usable temperature range: −10 to +80°C
Frequency Stability: +/−15 Hz (full temperature range)
Dimensions: 425 mm x 149 mm x 411 mm (WHD)
w/o projections: 16.5 in x 5.8 in x 16.0 in
Weight: 23 kg 50.6 lbs.

Receiver

Conversion System: SSB, CW, RTTY, AM quadruple conversion
FM triple conversion

IF Frequencies (in MHz):

	SSB	CW/RTTY	AM	FM
1st	46.5115	46.5106	46.5100	46.5100
2nd	9.0115	9.0106	9.0100	9.0100
3rd	0.4550	0.4550	0.4550	0.4550
4th	10.6950	10.6950	10.6950	n/a

Sensitivity (preamp on):
SSB/CW/RTTY
for 10 dB S/N
0.1–0.5 MHz less than 0.5 microvolt
1.8–30.0 MHz less than 0.16 microvolt
AM
for 10 dB S/N
0.1–0.5 MHz less than 3.2 microvolts
0.5–1.8 MHz less than 6.3 microvolts
1.8–30 MHz less than 1.0 microvolt
FM
for 12 dB SINAD
28–30 MHz less than 0.23 microvolt
Squelch Sensitivity: less then 0.23 microvolt
Selectivity: SSB, CW wide, RTTY wide, AM narrow
more than 2.4 kHz/−6 dB
less than 3.8 kHz/−60 dB
CW narrow, RTTY narrow (with CW250 Hz off)
more than 500 Hz/−6 dB
less than 1 kHz/−60 dB
CW narrow, RTTY narrow

Selectivity (continued)
(with CW 250 Hz on)
more than 250 Hz/−6 dB
less than 800 Hz/−60 dB
AM wide
more than 6 kHz/−6 dB
less than 15 kHz/−60 dB
FM
more than 15 kHz/−6 dB
less than 30 kHz/−50 dB
Spurious and Image Rejection Ratio:
Image: less than −80 dB
IF: less than −70 dB
Audio Output: greater than 2.6 W at 10% distortion (8Ω load)
Notch filter attenuation: greater than 45 dB
RIT Range: +/− 9.99 kHz

Transmitter

Maximum Output Power (Watts)

SSB (PEP)	150
AM	75
CW	150
RTTY	150
FM	150

Modulation:
SSB: balanced modulation
FM/RTTY: reactance modulation
AM: low-level modulation
FM Deviation: +/−5 kHz
RTTY Shift: 170, 425 & 850 Hz selectable
Spurious Emissions: less than −60 dB
Carrier Suppression: less than −40 dB
Unwanted Sideband Suppression: less than −55 dB
Microphone Impedance: 600Ω

Antenna Tuner

Output Matching Range: 16.7 to 150Ω unbalanced feedline
Minimum Input Power: 15 Watts
Band Switching Time: less than 3 seconds
Auto Tuning Time: less than 3 seconds
Auto Tuning Accuracy: VSWR less than 1.2:1
Insertion Loss: less than 0.5 dB (after tuning)

CRT Display

Output level
Composite video signal: 1 V p-p
Video components: 0.7 p-p positive
Synchronous components: 0.3 p-p negative
Output impedance: 75Ω
Usable humidity range: 10–90% (keep from moist environments)
Horizontal frequency: 15.75 kHz
Vertical frequency: 60 Hz

The keyer behaved wonderfully, offering full break-in and semi-break-in operations. There is, unfortunately, only an internal adjustment for dit-dah ratios.

The monitor feature allows you to hear your SSB audio component, making it easy to adjust the speech processor, and the microphone's tone and drive, as well as letting you hear other imperfections on your signal. The audio and CW signal reports I received were all good.

The built-in antenna tuner is fast, and it will handle most cleanup jobs caused by excursions within a band. It will not tune "Grandma's bedsprings." It can handle SWR mismatches only to 3:1.

The circuit used to key linear amplifiers is stout enough only for modern 12 volt circuits. To use it on anything else could cause damage. I recommend using an external relay. The IC-781 is not alone in this deficiency; most other makes and models suffer from a similar shortcoming.

Bench Testing

Bench testing is the only true method of measuring the performance of a transceiver. Personally, I feel that all of the currently available CPU-based HF transceivers are capable of performing above and beyond the capabilities of the human ear, and certainly over the poor band conditions that we all too often experience. The IC-781 is no exception to the rule.

I used the following lab equipment to check the performance of the IC-781:

- •Leader LDC 8243 Frequency Counter
- •Marconi Instruments 2022 Signal Generator
- •Hewlett Packard 606 HF Signal Generator
- •Hewlett Packard 651A Audio Generator
- •Bird 43 Wattmeter
- •Hewlett Packard 8551B/851B Spectrum Analyzer
- •Cushman CE-5 Monitor
- •Tectronics 475 Oscilloscope

Any Complaints?

There is little fault to find with the IC-781. It is a well-designed unit, built with the operator in mind. There were a few things, however, I didn't care for.

The digital key pad is important for operating dexterity, and allows you to enter a frequency without turning the main tuning knob. I was, however, surprised to discover that when I entered a frequency directly, the digital key pad mode did not automatically change. For example, 7.255 MHz is on LSB, but when you've made that selection from a previous setting of 14.313 MHz (USB), the USB mode will follow. In other words, there is no bandplan programmed into the unit.

Second, I don't care for the dot-type presentation of the surrounding spectrum on the display. A real scope trace is easier to read.

Third, even though the IC-781's overall appearance is truly a "ten," after setting it up, I noticed that I had a problem reading the control labels, which are medium gray on a nearly black background. A few are red, but none are easily seen in typical lighting. The white lettering on my 735, 751A, and 140, is easily readable.

Not all operators will use every feature of the IC-781, and to some the unit would be unacceptable due to its complexity. To others the price might be extravagant. However, feature for feature, the IC-781 is the most capable piece of HF equipment currently available. I feel comfortable recommending the IC-781 as a true state-of-the-art, unique piece of equipment.

Where Do the Dollars Go?

I've heard some interesting comments about the IC-781. Among them are: It costs more than my first house. My pickup truck cost less than the IC-781. Who is going to fix it when it breaks? If I take that home, I'll be getting a divorce. It doesn't do that much more than a $2,000 radio. It's so heavy, it would crush my desk.

Most of the comments are about the IC-781's cool list price of $5,995. That ain't hay, my friend. However, let's put these numbers into perspective. In 1958, you could buy a Collins 32S1, 75S1, and the goodies to go with it, for about $1,590. That was in the day of the $15,000 house and $2,500 automobile. Today the home will cost nearly $100,000 (depending upon geographical location) and the family chariot about $15,000. Perhaps these numbers place the high price of the IC-781 more in line with today's economy.

I have included a chart of the manufacturer's specifications to show how the various top dollar rigs compare. The IC-735 is included on the chart just to put some depth into the study of cost vs. what you get.

"Thank you" to the folks at the Electronic Equipment Bank of Vienna, Virginia, for the loan of an IC-781, and the use of their very complete test bench. 73

Comparative Specifications Chart for HF Transceivers

Make/Model	ICOM 781	Kenwood TS-940	ICOM 761	Ten-Tec Paragon	Yaesu 767	ICOM 735
Dimensions(hwd)	8x16.7x16	5.5x15.8x13.8	5.9x16.7x15.3	5.8x14.8x17	5.2x14.5x11.5	4x9.5x9.4
Weight	50.6	40.8 lbs	38.6	16 lbs	30 lbs	11 lbs
Display	flourescent	flourscent	flourscent	flourescent	flourescent	LCD
Freq. stability	±15 Hz	±100 Hz	100 Hz	±30 Hz	30 Hz	±30 Hz
Internal AC power	yes	yes	yes	no	yes	no
Transmitter						
RF input		250 watts		200 watts		200 watts
output	150 watts		100 watts	100 watts	100 watts	
adjustable	yes	yes	yes	yes	yes	yes
Harmonic supp.					50 dB	40 dB
Spurious supp.	60 dB	40 dB	60 dB	45 dB		50 dB
Carrier supp.	40 dB	40 dB	40 dB	60 dB	40 dB	40 dB
Unwanted sideband	55 dB	50 dB	55 dB	60 dB	50 dB	50 dB
Microphone	600 ohms	500-50K ohms	600 ohms	Hi/Lo	500-600 ohms	600 ohm
Receiver						
Receiver IFs	four	four	four	three	three	three
1st IF	46 MHz	45 Mhz	70 MHz	75 MHz	45 MHz	70 MHz
2nd IF	9 MHz	8.8 Mhz	9 MHz	9 Mhz	8.2 MHz	9 MHz
3rd IF	455 kHz	455 kHz	455 kHz	6.3 MHz	455 kHz	455 kHz
4th IF	9 MHz	100 kHz	9 MHz			
Sensitivity (HF)	.16 micro volt	.2 micro volt	.15 micro volt	.15 micro volt	.25 micro volt	.15 micro volt
Selectivity SSB/CW	2.4 kHz/- 6dB	2.4 kHz/- 6dB	2.4 kHz/- 6dB	2.4 kHz/- 6dB	2.7 kHz/- 6dB	2.3 kHz/- 6dB
	3.8 kHz/-60dB	3.6 kHz/-60dB	3.8 kHz/-60dB	3.4 kHz/-60dB	4.5 kHz/-60dB	4.0 kHz/-60dB
Dynamic range	105 dB	102 dB	105 dB	100 dB		105 dB
Spurious rej	70 dB		80 dB			80 dB
Image ratio	80 dB	80 dB				
Image rej		70 dB	80 dB	80 dB	70 dB	80 dB
Notch att	45 dB	40 dB	45 dB	50 dB	30 dB	30 dB
Audio output	2.6 watts	1.5 watts	2.6 watts	1.5 watts	1.5 watts	3 watts
Memories	99	40	32	62	10	12
PBT	yes	yes	yes	yes	no	yes
IF shift	yes	no	yes	no	yes	no
Dual VFOs	yes	yes	yes	yes	yes	yes
RIT	yes	yes	yes	yes	no	yes
AGC selectable	yes	yes (2 + off)	yes	on/off	yes (3 + off)	yes
Split operation	yes	yes	yes	yes	yes	yes
Speech proc	yes	yes	yes	yes	yes	yes
Noise blanker	yes	yes (2)	yes	yes	yes	yes (2)
Internal ant tuner	yes	option	yes	no	yes	optional
Freq keyboard	yes	yes	yes	yes	yes	no
FM	yes	yes	yes	option	yes	yes
Keyer	yes	no	yes	no	yes	optional
Opt filters	yes	yes	yes	yes	no	yes
Rec-preamp	yes	no	yes	no	yes	yes
Rec-att	yes	yes	yes	yes	yes	yes
List price	$5,995.00	$2449.95	$2699.00	$2245.00	$1929.95	$1099.00
Remarks	CRT display of parameters & spectrum	scope option clock/timer 10 Hz readout variable bandwidth tuning Hi-Lo cut PBT	audio monitor best tuning knob feel	10 Hz readout labeled memories Made in USA	VHF/UHF options built-in 600 Hz filter CAT system	very small size optional external automatic antenna tuner

specifications above are as listed on manufacturers advertising/sales literature

Comparative specifications chart for HF transceivers. This chart was complied by the author and produced on his PC-DOS compatible and Ashton Tate's Byline™ desktop publishing software.

Number 7 on your Feedback card

73 Review *by Peter Ferrand WB2QLL*

Just The FAX

Info-Tech M-800

Universal Radio
1280 Aida Drive
Reynoldsburg, OH 43068
PH: (614) 866-4267
Price Class: $300

This little black box says it's a FAX converter, and if you know what that means and want to receive lots of FAX pictures, the Info-Tech M-800, manufactured by Digital Electronic Systems, is probably the best low-cost way to do the job. If you're wondering just what FAX is, or asking: "Can't I just use my computer?" or "Does it smell bad?" then it's time for an explanation. Here is a unit that does exactly what it's supposed to do. As long as that matches your requirements, it's a worthwhile investment.

Facsimile, or FAX, is a mode whereby still pictures are transmitted at resolutions of 800 or more lines per frame. In order to fit that much data into a bandwidth no larger than an audio channel, it can take from five to fifteen minutes to send one picture.

While FAX is still a little known mode within the ham community, there are many FAX transmissions available, both on shortwave and direct via satellite. The great bulk of commercial and government FAX are weather charts, plus a good assortment of press photographs from wire services worldwide.

The M-800

The M-800 is designed as a low-cost way to get those images to form on your printer simply and reliably with a minimum of fuss. While not intended as a piece of ham equipment, it is designed to duplicate most of the functions of the dedicated commercial FAX units while using an ordinary computer-type letter quality dot matrix printer.

In contrast to commercial FAX units, the M-800 will receive images from a variety of different sources using different data transmission standards. Commercial FAX systems are generally set up for one standard for a particular service, and use various and sometimes odoriferous electrochemical printing techniques that require forty to fifty cents' worth of paper per page.

FAX, also known as radiofax, is one of the many weird noises heard while tuning across the shortwave or satellite bands. Once you've figured out how to pick up a given signal emanating from a given transmitter, it only takes a few seconds to set things up again. For new stations, it's a lot like trying to pick up commercial RTTY services—there's quite a bit of trying various combinations of equipment settings before you see some intelligible output. The M-800's manual repeatedly mentions the need for patience in this sort of experimentation, so if you aren't prepared to invest some time (and printer paper!), you'd better be satisfied with picking up nothing more complex than the National Weather Service charts.

Interfacing the M-800

The M-800 is simply a small box that connects a receiver and a printer. The receiver should be high quality because drift, distortion, images, and other flaws will severely reduce the quality of the FAX image. The receiver section of any of the current general coverage synthesized sideband transceivers should suffice, although I have obtained better results by using modern commercial or military shortwave receivers because of their better front ends and lower levels of distortion.

For satellite reception, which I didn't try, the manual says you'll need to use the unfiltered baseband video output of the satellite receiver, and feed that into a general coverage receiver capable of tuning 0–13 MHz, which can receive FM. Satellite signals appear on the 135–138 MHz band, as well as on the S, C, and Ku bands.

The printer should have a parallel interface and match the control codes of either the Epson LQ-800 or the Epson FX-85/86. The LQ-800, a 24-wire printer, will produce higher quality images.

My printer is an Epson with a serial interface. This interface problem is simply (but rather expensively) solved by using a Quadram Microfazer serial-to-parallel converter. The important thing is for the printer to respond to the bit-mapped graphics that the standard Epson uses.

Setting the M-800's Controls

Other than the on-off switch and a switch to change from AM to FM demodulation, the M-800's controls consist of six momentary contact push buttons. These buttons control formatting, such as the speed of the received FAX signal, the height-to-width ratio (known as Index of Cooperation, or IOC), the direction

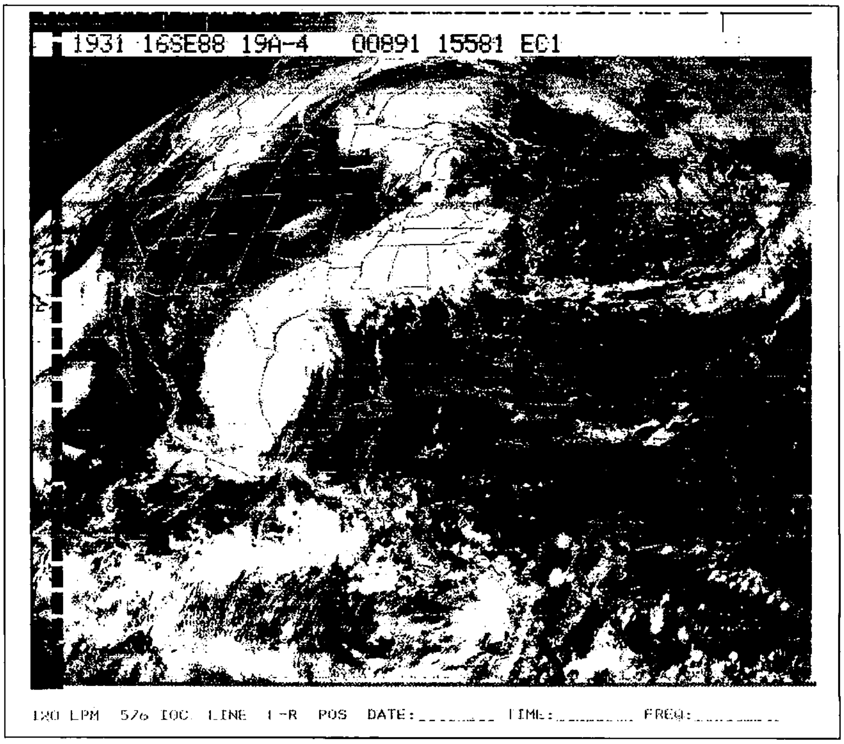


Figure 1. FAX image of a press photo. The GRAY *mode is used here to give shading. This image shows the center of Hurricane Gilbert passing over Eastern Mexico.*

(whether the picture is drawn from right to left or left to right), and the polarity (whether the picture should be printed as a negative or a positive).

You can adjust these controls on the fly. If you are printing out something and it doesn't look right, you can change the settings, and in two minutes or so you'll know if you are getting any closer. Some of the settings are optional; cloud patterns, for instance, are supposed to be printed as white clouds on a dark earth, but there will be less wear on the ribbon and the printer if it's printed as a negative.

The M-800 also provides a choice of LINE or GRAY mode. For hand drawn weatherfax charts, LINE provides the greatest detail and black and white contrast. The GRAY mode is used to give shading for press photos.

There is also a control for manually starting and stopping the printing operation. In the ideal case, the M-800 will pick up the start tones at the beginning of each picture from the transmitting station and start the printer by itself, then stop it when the picture is done. But sometimes you may want to start the picture yourself, such as when you happen to tune into a FAX station in the middle of a transmission. Stop signals are not completely standardized, so the converter will not always pick them up. In that case, you can stop the printer manually.

A FRAME button moves the image to the left in half-inch increments. This feature is useful because, when a picture is manually started, it is not likely to be lined up properly on the page. A group of LEDs above the buttons provide a status read-out of button settings.

The only tuning indication is an LED labeled TUNE, which lights up when the signal is properly tuned in. Since I'm used to an oscilloscope for tuning, the single LED seemed a bit spartan. I was never sure if I had actually tuned in a signal correctly. Yet the LED is sufficient because the actual tuning of FAX is not nearly as critical as RTTY, and picture quality, especially darkness and lightness, can be varied as a function of the tuning. I'd still prefer an output for a scope, though.

"The M-800 is simply a small box that connects a receiver and a printer."

Installation, Set-up, and Operation

The installation and set-up of the unit is straightforward and proceeds just as the manual indicates. The manual, though not polished in appearance, is readable, complete, and well-organized for someone with a basic knowledge of radio or shortwave listening. Someone who has played with receivers and RTTY will have no problems whatever. There are plenty of examples of properly and improperly tuned FAX pictures. The manual also includes information on getting paper and ribbons, a starter list of FAX stations to tune in, and even a schematic for those of us who feel cheated if we don't know what it is we've bought.

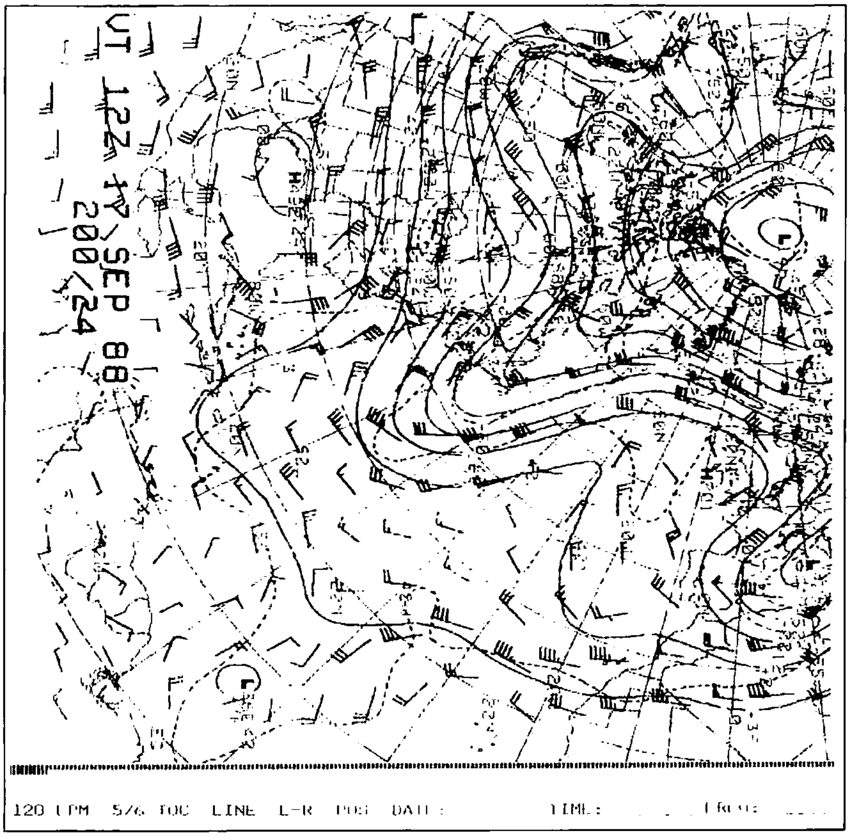


Figure 2. Image of a hand-drawn weather chart. For hand-drawn weatherfax charts, LINE provides the greatest detail and black and white contrast.

The M-800's internal construction and workmanship is excellent, with all chips in sockets and even an internal fuse in series with the 12 volt input.

Info-Tech products are manufactured in Fort Lauderdale, Florida, by Digital Electronic Systems, the successor firm to the original Info-Tech organization. The exclusive retail distributor for DES is Universal Shortwave Radio of Reynoldsburg, Ohio, which also deserves a good word. Not only has Universal's customer service met my every expectation, but Universal maintains a computer bulletin board known as UBIX for the exchange of information of interest to shortwave listeners, and publishes a periodical, *The RTTY Listener*, which lists frequencies and stations for shortwave listeners using all the digital modes, including FAX.

Once you are familiar with the M-800 and FAX, operation is simple. You tune in the signal, set the parameters on the M-800 front panel, and start up the printer. If a station using a standard format is being received, the M-800 will just keep printing out pictures, a new one on every page. If you choose, you can have the M-800 print out a status line at the bottom of every page listing all the parameters involved, along with spaces for you to write in, by hand, a log entry for the date, time, and frequency.

Finding new stations will generally show the results of your trial and error testing of the various possible settings—many pages will print out what can most optimistically be called "abstract art."

No Computer Necessary

Up-to-date readers will undoubtedly note that computers have not been mentioned yet. That's because the M-800 needs no additional computers hooked to it. While the M-800 can share its printer with your personal computer, there is no provision within the M-800 for any data transfer between the M-800 and a computer. The M-800 takes in audio from a receiver and puts out data formatted for a parallel printer—it does nothing more. If you are thinking of buying the M-800, take note that there's no way to control it by computer, and no simple way to save the FAX images.

The multimode demodulators, such as the PK-232 and the KAM, are computer controlled, and the images can be saved on the computer's disk. Furthermore, with these units, the images are displayed, albeit with less resolution, on the computer's video screen as they are sent. Although just as time consuming, your experiments don't use up reams of paper.

What you get with the M-800, then, is a unit that works well, with the versatility to print whatever most people want to print. For those who want—here it comes, folks—"just the FAX," it will keep printing pictures without a lot of fuss, bother, or fooling with.

73 Review

by Bill Clarke WA4BLC

The Shakespeare Big Stick

Shakespeare Company
PO Box 733
Newbury, SC 29108
Price Class: $83

Get into some 10-meter DX with this vertical.

In the middle '70s, the Shakespeare Company produced an antenna for the 27 MHz Citizens' Band, called the Big Stick. Now, recognizing the upsurge of sun-spot activity, which means heightened activity on the higher frequency HF bands, the Shakespeare Company revived it as a 10 meter antenna. The current antenna—the Super Big Stick III—is really just the same antenna as before, namely a light-weight Fiberglas™ half-wave vertical antenna. It now comes, however, with a chart of instructions on how to cut it (i.e. trim it for resonance) for operation in the nearby ham band.

A Little Theory

You can describe this vertical half-wave antenna, for ease of visualization, as a center-fed dipole that stands on end. It is a modification of the once popular hypodermic or coaxial antenna. Its Fiberglas™ covering adds strength, durability, and safety. Most importantly, you don't need ground radials with this type of antenna. All you have to install is a single vertical element about sixteen feet tall.

Due to their physical characteristics, vertical antennas are better low-angle radiators than horizontal antennas. For example, a vertical dipole with the feedpoint ¼-wavelength high produces a pattern of radiation from 0–60 degrees, the major portion of which is below 40 degrees. A comparable horizontal dipole radiates at 10–90 degrees, with the major portion of RF going out at higher than 50 degrees. This is important for DXing—low-angle radiation means greater distance per skip.

A quick look at the *ARRL Antenna Handbook* or similar source shows you can obtain very low-angle radiation at a height of only 1-½ wavelengths. This height shows an interesting combination of major lobes at several angles from very low to very high. The height of 1-½ wavelengths is only 24 feet for 10 meters. In the case of the Big Stick, this means you only have to get the bottom of the antenna up about 16 feet from the ground.

Installation

This is very simple. The Big Stick comes in a round cardboard shipping tube and consists of three parts which you merely screw together. There is a metal sleeve at its base which is the attachment point for mounting it. Any typical TV hardware with two attach points will suffice. Check with Radio Shack; they have chimney, vent pipe, eave, and wall mounts. Generally, their hardware costs under $12.

You could also fabricate a mount and put it on a push-up tower. This is what I did, and it placed the feedpoint more than fifty feet in the air. Wind load is very low for this antenna, so I'm not too worried about problems with weather.

I recommend RG-8X coax, unless you wish to spend a few extra dollars for RG-8 or RG-213. Personally, I use RG-8X for all my HF feedlines. It is inexpensive, and much easier to work with than the big stuff.

Be sure you waterproof the cable connection at the base of the Big Stick. For my weather sealing applications, I use glue made for fixing running shoes. One tube, which costs just a few dollars, seals 20–30 connections.

Before installing the Big Stick, trim it to the correct length, as recommended by Shakespeare, for the frequency you plan to operate on. The instruction sheet gives measurements for obtaining resonance at various locations within the band. Use a fine-toothed hacksaw to cut the antenna.

Manufacturer's Specifications

Model 376-GB Gold Band Big Stick III Antenna

Frequency Coverage:	27–30 MHz (adjustable by trimming)
Radiator Length:	approx. 18 feet
Maximum Wind Load:	96 MPH, 86 MPH with 1″ radial icing
Polarization:	vertical
Gain:	7.65 dBi
Feed line:	50Ω coax
Connector:	SO-239
Matching Method:	internal (designed for broad-band)
Power Rating:	1000 Watts
Recommended Height:	min. ¼-wavelength (8 feet)
Radials:	not required

SWR Plots

28.0	1.7
28.1	1.65
28.2	1.6
28.3	1.45
28.4	1.4
28.5	1.35
28.6	1.4
28.7	1.5
28.8	1.6
28.9	1.8
29.0	2.1
29.1	2.5
29.2	2.8
29.3	3.0
29.4	3.5
29.5	4.0+

The Big Stick antenna is protected to 14,500 volts against direct contact with power lines. It is protected from lightning by its DC ground.

Performance

First, understand that the Big Stick is an omni-directional antenna. This means that it hears and talks in all directions at the same time. If the band is wide open, you hear wide open in all directions.

The first station I worked was KL7LF, on the third try in a very heavy pileup. He was 5-9, and gave me a 5-7. Before the evening was over, I had worked everything I heard in the Pacific area and many US stations.

SWR readings were favorable (see chart below). Purists look to always get the SWR down to 1:1. Most of the modern transceivers, however, can easily cope with SWR of 2:1 or less in normal operation.

I was pleasantly surprised to find that the Big Stick worked well on 15 meters. The SWR varied from 1.7:1 at 21.0 MHz to 2.1:1 at 21.4 MHz. Nice coverage I had not planned on.

Warranty

Now here's a twist—a real warranty on an antenna. The Big Stick is warranted for 2 years against manufacturing defects in materials or workmanship. Of course, you are responsible for shipping costs if you need to send it to the factory. But now for the zinger: for an additional $10, you can extend the warranty coverage to four years. This makes me think the Shakespeare folks are proud and sure of their product. You just don't offer warranties on any old thing that sits outside in the weather day after day unless it really is good.

In Conclusion

Yep, it works! I was very satisfied with the Big Stick's overall performance. It is easy to put up and doesn't cost much. It might be a good antenna for portable use, also, as the three sections unscrew and can be carried in the shipping tube, which is only six feet long.

If you trim it further, you should be able to peak the antenna for the higher end of the 10 meter band, making it a good performer for 10 FM.

I recommend the Big Stick to any 10-meter enthusiast who can install it at least 16 feet in the air.

A One-Stage 80 Meter CW Transmitter

Home-Brew Fun

by Mark A. Boucher WB3ELL

After your first contact with a rig you've built yourself, you'll understand why old-time hams make such a fuss about the fun they had building their own ham gear in the old days. You may be starting to pale on your several kilobuck all-band transceiver, but I'll bet once you start making contacts with this 80 meter transceiver, you'll be hooked.

I've tried several circuit variations and found that this one uses the fewest parts and gives the best performance. Even better, if anything ever does go wrong with it, you'll be able to fix it yourself. You won't need a modern laboratory to check microprocessor controls.

The only major problem with this transceiver will be getting you to shut up about the fun you're having with it and to stop driving your ham club members bananas. You might just talk'em into making a club project out of it.

Overview of the 80 Meter Transmitter

During receive this radio is basically an 80 meter crystal-controlled self-excited direct conversion receiver; during transmit it is a power RF oscillator. The weakest audible signal is 0.1 to 0.3 microvolts. The power out during transmit is in the 1 to 3 Watt range, and runs on 12 volts DC.

The single stage that this unit uses is an IRF-511 high gain power MOSFET (RS 276-2072). I screwed two Caltronics HS-109 heat sinks to the MOSFET, after spreading thermally conductive paste between them. During receive, this stage acts as a low-level RF oscillator with the RF coupled to a 3-diode detector circuit. The audio output from this is amplified back through the same power FET, going through a 1k to 20kΩ step-up transformer to a quality crystal earphone. This audio output configuration is far more sensitive than anything else that I have tried.

During transmit, the receive section is switched out with the 6-pole T-R relay, and the same tuned circuit is switched back in to become a simple power oscillator. This unit also has a single red/green Tx/Rx LED.

Construction Details

During receive, the antenna (50Ω) is connected to J2 and switched from pins 2–20 of the 6-pole double-throw TR relay through C7

Photo A. The completed DMOS 80 meter CW transceiver.

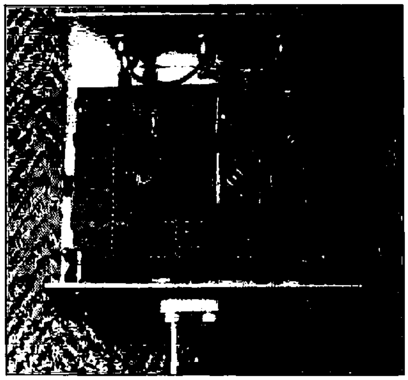


Photo B. An inside view of the DMOS 80 meter transceiver.

to the 8-turn tap of T1. T1 has 30 turns, tapped at 8, of #26 enameled wire on a T50-2 toroid. The high side of T1 is switched from pin 3 to 19 during receive. From there it goes to C15 to the diode detector combination D1,2,3. These are standard germanium detector diodes. The signal injection is through C16, a 2 pF capacitor, to the junction of crystal Y1 and crystal trimmer C2. The output of the detector goes through the parallel combination of RFC1-C14. This combination provides audio coupling and the right amount of RF to cause an increase in sensitivity due to regenerative gain. This is coupled through C5 to pin 13 to 9, which goes directly to the gate of Q1.

Q1 gets the right amount of bias with R1, a megohm trimpot. The drain of Q1 goes to pin 8, which is switched to pin 14 during receive. Pin 14 goes to the 1k ohm primary of audio transformer T2. The 20k secondary goes to the crystal earphone through C20 to J4. Also at this point are C17-C18, which attenuate the higher audio frequencies for a narrower receive bandwidth, and D4-D5 that limit the amount of audio going to the earphone and eliminate a severe transmit-receive keying click.

Crystal Y1 is a general purpose, higher drive fundamental 80 meter crystal (I.C.M. p.n. 031080). This crystal is switched in series with the parallel combination of C2-C19 during receive. C2 is the crystal trimmer adjustment. The receiver is most sensitive when the trimmer is at the minimum capacitance the oscillator will consistently start at. When adjusted to this point, the oscillator frequency is shifted higher by several hundred Hertz. During transmit, this is shorted out to give the oscillator more power and to provide the necessary sidetone shift between transmit and receive to be able to hear stations transmitting on your frequency.

During transmit, the +12 volt supply to the drain of Q1 is switched from T2 to T1 through pins 8 to 16 and pins 3 to 17. The transmit antenna is connected from pins 2 to 18, which then go to C8 and the drain of Q1. The high side of T1, which is already connected to the drain, also has the low side of the 3 transmit tuning caps C11, C12, C13 switched to ground through pins 10 to 11. Also, during transmit, the source of Q1 is grounded through pins 22 to 1.

This radio also has a red/green transmit/receive LED indicator. The +12 volts go through two 1.2k resistors R2 and R3, each to the red or green elements. During receive, voltage to the red LED is shorted to ground through pins 21 to 1. During transmit, voltage to the green LED is shorted to ground through pins 11 to 10, which are isolated from the transmit capacitor ground line by RFC2, the other 330 μH choke.

On the +12 volt input line, through J1, I put D6, a 3A, 50 volt silicon rectifier for reverse polarity protection, and from there to the power switch and filter caps C3,C4.

The keyline comes in through J3, and goes to pin 5, the minus side of RY1, the TR relay. The other side, pin 6, has +12 volts on it. This relay keys normally

Continued on page 30

Number 37 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free, on a space-available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly on a full (8½" x 11") sheet of paper. Double-space and use upper- and lowercase letters where appropriate. Also, write numbers carefully—a 1, for example, can be read as an l or an i, or a 7 as a 1. Thanks for your cooperation.

Need schematic, etc., for Delco 30BCTS1 from Sam's AR-339. Will pay postage and copying costs.

Lisle T. Hines K2QLA
11 Meadow Drive
Homer NY 13077

Wanted: Manual and schematic for KLM linear amplifier, Model No. 30-140B. Will gladly pay copying and mailing costs.

Edward Moiser N8IOV
4376 Coolidge Road
Coleman MI 48618

I am looking for the following items (please state price and/or condition in correspondence): Two MRF-455 A transistors; MFJ-962, -949C, -941D, or -989 antenna tuner; five 7868 tubes; 10 #12 6-V lamps for Bogen PA Amps; one bandswitch each for the Panasonic RF 2800 receiver #RSR 98W or equivalent; one printer and disk drive for the Tandy Color Computer II Model 26-3127; and one Z-80/CPM and Modem Board for the Apple IIe Pro System.

Mike Adams
Haney Vo-Tech Center
3016 Hwy 77
Panama City FL 32405

I'm looking for manuals and/or schematics for a Heathkit model GR-91 receiver. I'll gladly pay for any costs incurred.

Darrel L. Daley KL7DN
Radio Free Vermont
P.O. Box 445
Putney VT 05346

Does anyone know where I might purchase a new or used TK-1/BC-1 memory backup power supply for my Kenwood TR-7800? It is a small AC adapter that plugs into a wall outlet and retains the memory frequencies in the TR-7800. Thank you.

Michael A. Horn
516 Union Place
Fremont OH 43420

I would like to hear from anyone who uses the Tandy Model 100 and 200 for amateur radio. I am interested in any programs, especially satellite tracking.

Scott Harvey KA7FVV
2517 N. Calispel
Spokane WA 99205

Continued from page 28
with either a hard or an electronic keyer.

I mounted the parts on top of a Radio Shack 276-16B printed circuit board, and soldered wire jumpers between the different components on the bottom of the PC board. The bottom is quite a mess! It is also important to keep the crystal leads as short as possible, or to mount the crystal on the board itself, as with longer leads. The crystal has lower RF drive going to it, and a tendency not to start. I found this out when I mounted the crystal on the front panel.

Tuning the 80 Meter Transmitter

As for tuning the unit up, make sure that the crystal oscillator is running. The best way is by listening to it on another 80 meter receiver. You would want to make sure that the crystal trimmer capacitor is tightened down all the way, at maximum capacitance, and then adjust the 1 megohm trimpot R1 to the point where the crystal oscillates, which should be about mid-range. Then put an RF signal generator in on the antenna input. Or you could hook the antenna up to it and run a different 80 meter transmitter into a dummy load as a signal source. You then adjust receive tuning trimmer C1, a 600 pF trimmer, for a peak in the audio tone in the earphone. If you do not get a peak you may have to increase or decrease the value of C10, a 150 pF fixed cap.

When you have a peak, the next step is to adjust the crystal trimmer C2 for the least capacitance that the oscillator will consistently run at. You may have to readjust R1 slightly to do this. The next step is to hook this up to a wattmeter, preferably with a dummy load on it. I have a Heathkit HM-9 QRP wattmeter and an HFT-9 antenna tuner that work fine with this unit. Now, with the unit keyed, it should read about 1-5 Watts out during transmit. You should, of course, listen to the transmitter with an 80 meter receiver to make sure that the keying is clean. If the oscillator starts a little too slowly during transmit, readjusting R1 slightly should take care of it.

Transmitting

Next, hook it up to the antenna and try transmitting. If you have a high SWR, Q1 will get quite warm. When this happens, the gain drops slightly. During receive this could cause the oscillator to cut out. You might have to increase the crystal trimmer C2 capacitance or change R1 slightly to make this work correctly. So initially, there is a kind of balancing act between these controls, but when adjusted correctly it is sensitive, stable, and has enough power out to make more than local contacts.

If you have a frequency counter, you might want to make sure that the output during transmit is on 80 meters. If you use a cheap, low-drive crystal, such as a 3579 kHz TV, you could have 40 meter and higher harmonics during transmit, due to the high gain of Q1. You may have to add an 80 meter bandpass filter at the antenna, but with the ICM crystal, and the right values of switched-in parallel tuning capacitors C11, 12, and 13, this is not a problem for me.

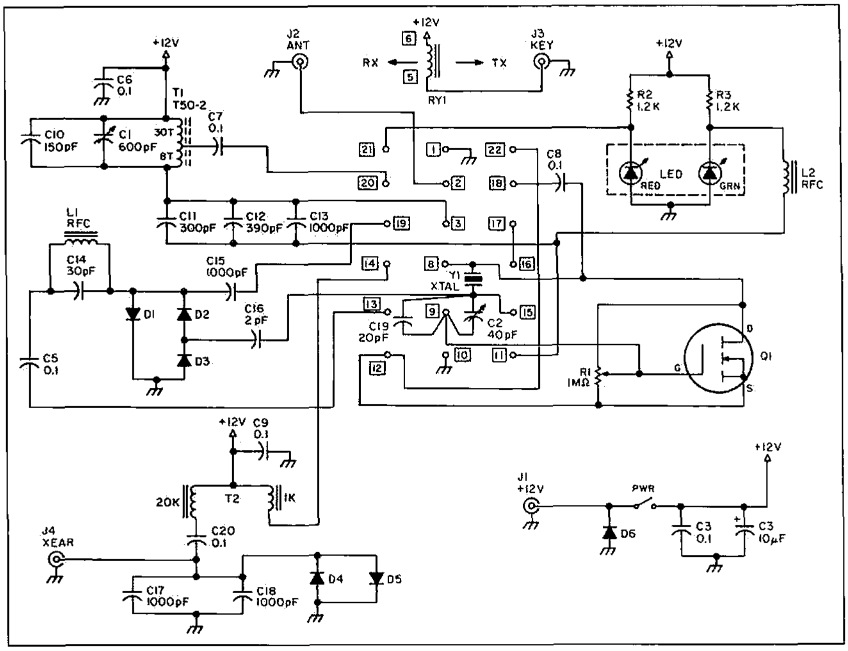


Figure 1. Schematic of the WB3ELL DMOS 80 meter CW transceiver.

Operating the 80 Meter Transmitter

For actual operation, I have a 66-foot, low long-wire, grounded only by water. But I have, even during daytime, contacted KA3CKS, a cousin of mine who lives 12 miles south of here. He has a similar antenna, and a typical 100 Watt output transceiver. At

Parts List

1 Stage 80 Meter CW Transceiver

Symbol	Supplier	Part No.	Description
Q1	Radio Shack	276-2072	IRF-511 N-Channel Power MOSFET
LED 1	Radio Shack	276-025	Red/Green LED
D1,2,3	Radio Shack	276-1123	Germanium Detector Diodes
D4,5	Radio Shack	276-1101	1A,50 V Silicon Rectifiers
D6	Radio Shack	276-1144	3A, 50 V Silicon Rectifiers
RY1	Aromat Corp.	NL6EX-DC5V	6PDT TR Relay
Y1	Intl. Crystal	031080	80 M Experimenters' Crystal
XEAR1	Philmore	747	Crystal Earphone
T1	Amidon Assoc.	T50-2	Toroid
T2	Calectro	D1-719	1k/20k Audio Transformer
RFC1,2	J W Miller	9230-80	330 μh RF Choke
R1	JIMPAK	840P1 Meg	1 Megohm, ½ Watt PC Pot
C1	Calectro	A1-249	600 pF Compression Trimmer
C2	Calectro	A1-246	40 pF Compression Trimmer
C3	Panasonic	A1CV100	10 μF, 100 V Electrolytic Cap.
C4,5,6,8,9,20	Panasonic	21CM100	0.1 μf, 100 V Cap.
C7	Panasonic	21CM010	0.01 μF, 100 V Cap.
C13,15,17,18	Panasonic	21CM001	0.001μf, 100 V Cap.
C12	Elmenco	DM10-391J	390 pF Cap.
C11	Elmenco	DM10-301J	300 pF Cap.
C10	Elmenco	DM10-151J	150 pF Cap.
C14	Elmenco	DM10-300J	30 pF Cap.
C19	Elmenco	DM10-200J	20 pF Cap.
C16	Elmenco	DMIO-020D	2 pF Cap.
SW1	Radio Shack	275-625	Micro Power Switch
J1,2,3	Radio Shack	274-376	Phono Jacks
J4	Radio Shack	276-24B	Mini Phone Jack
YS1	Steatite	33302	Crystal Socket
HS1,2	Caltronics	HS-109	Crystal Heat sinks
PCB	Radio Shack	276-168	Printed Circuit Board
CASE	Ten-Tec	TG-24	Enclosure

night, there is rarely a lack of signals in the 80 meter Novice band. The crystal I have at the moment is 3725 kHz, but I would recommend getting a 3710 kHz, because that is the QRP frequency and, at 3725 and above, there are Canadian SSB stations that cause interference.

The other 80 meter QRP frequencies are 3560 and 3535 kHz, but I rarely hear much activity on those frequencies with this radio. I have made contacts on the Novice band at night, when QRM happened to be at a lull at 3725, with local signals being loud and weaker signals coming from stations further away. With this radio I could not make any more contacts on 3725 than with my Ten-Tec Argonaut using the antenna I have, even though it is a vastly better radio.

One of the possible improvements to this radio would be to add a varicap in place of the crystal trimmer. You could give a crystal high drive to start it switching from transmit to receive, then reduce the drive by cutting back on the capacitance to the point of just oscillating. Also, low drive crystals might work with this and series resistance to the crystal. With this, the radio could work better on 24 volts, where now it has a reduction in gain instead of an increase.

You do not have to use the 6-pole double-throw TR relay. You could, of course, use a front panel 4-pole double-throw switch, and a 2-pole TR relay as long as you put the relay on the source-to-ground contacts, pins 1, 21, 22 and 10, 11, 12. Or you could have three 2-pole, double-throw DIP relays hooked together. Another solution would be to use a 4-pole front panel TR switch, switching the right bias in to the gate of Q1 with the key down.

"As for tuning the unit up, make sure that the crystal oscillator is running."

Personally, I am quite poor at copying CW, but the furthest contacts were in the 200-mile plus range. I had to struggle to pass my 13 wpm code test 12 years ago, but I still enjoy listening to CW and trying to make an occasional contact. I mainly enjoy low-band HF phone contacts.

Since this radio has a direct conversion receiver with a high gain audio amplifier, it will require either a battery with +12 volt supply, or a properly filtered supply to eliminate direct conversion common-mode hum. The Ten-Tec supply I have now works perfectly well as is, with absolutely no hum whatsoever. Any recent *ARRL Handbook* shows the circuitry required to stop this hum.

Problems and Possibilities

Now for a few of the radio's inherent problems. First, I was quite surprised when I hooked this radio up to two different RF signal generators and found that the weakest audible signal was actually 0.1 microvolts. From the volume of received signals, I personally thought it would be in the 10 microvolt range. That is, the receiver is fairly sensitive, but the actual volume is on the low side, unless you are receiving stronger signals. Also, since this has an unbalanced diode detector circuit, it radiates a low-level oscillator on the antenna during receive, and does a great job of detecting AM signals. What this means is that while you can hear the CW signal you are trying to copy, you will also hear any strong local 75 meter SSB, and any strong local or foreign AM short-wave broadcasts.

On 40 meters and higher at night, this radio is totally saturated with AM short-wave BCI. Because this radio has a fairly low volume to begin with, any selective audio filter causes too much of a decrease in volume. The same thing occurs when putting a balanced diode detector on the front end of this receiver: too much of a loss in volume, so the oscillator is stuck with some antenna radiation during receive.

I have spent a lot of time trying to make simple improvements on this radio by adding additional stages. I had a dual-gate MOSFET mixer in place of the diode detectors. It had a slightly higher gain and a greatly reduced tendency to pick up unwanted AM BCI, but it still had the other drawbacks of the original radio. I also tried using the dual-gate MOSFET as a self-oscillating mixer, and the IRF-511 as the audio output. This had a substantially higher gain, but it had problems causing strong receive signals to cut off the oscillator, creating a squeal.

The Solutions

The combination that ended up working the best was a dual-gate MOSFET mixer, an IRF-511 oscillator/audio preamp, and an IRF-511 audio output. During transmit, they easily switched to 1 RF-511 as a power oscillator, and the audio output to a sidetone generator. This, of course, was a lot more sensitive. The signals on the low end of 40 meters at night were quite loud, only occasionally being wiped out by AM BCI, because there was enough audio output to use a CW audio filter. Still, signals on 40 meters daytime were rather weak. So these radios worked, but they still had the major inherent problem of being single frequency crystal-controlled direct conversion receivers. Using a sharp enough audio filter to cut down on interference, you could not tune the signals to a peak because there was no VFO, and a VCXO on 80 or 40 meters is really no good.

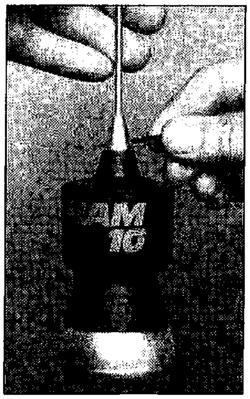
Originally, I had planned to sell this idea, or to sell these radios as kits. But given the inherent problems these CW transceivers have, I decided to make the lowband voice transceiver kit that I had started before I began playing around with this. If you decide to make this radio, have fun with it! ■

Number 10 on your Feedback card

73 Review *by Marc Stern N1BLH*

The Ham-10 Antenna

Your ticket to mobile 10 meter fun.



American Antennas
1500 Executive Dr.
Elgin, IL 60123
(800) 323-6768
Place Class: $50

American Antennas has been manufacturing antennas for both ham and CB markets for the last decade. Its first ham antenna was a quarter-wave 2 meter spike, designed for the K-40 mount. The greatly increased activity on 10 meters, due to Novice Enhancement, prompted this manufacturer to market a 10 meter version of their K-40 CB mobile whip. The only difference (besides the logo) is that its radiator is about six inches shorter than that of the 11 meter version.

The base loading coil is uniquely shaped, having a wide barrel-like enclosure for the coil with a top that tapers to the radiator. The body and top are made of high-impact plastic, while the antenna seat is made of stainless steel. The radiator inserts into the mount, with set screws to adjust the length.

The base coil has a quick disconnect feature. Made with a bayonet-style mounting mechanism, the Ham-10's body has a small lip on the bottom. Inside this part you will find the bayonet plate. Simply attach the mount to its base and make a one-quarter turn to the right, and the Ham-10 securely locks home. At this point, the antenna is ready to use.

An interesting sidepoint about the antenna's trunk lip base is its flexibility. A low-profile base, it has more than thirty degrees of tilt from vertical in a 360-degree arc. You should be able to mount it on just about any angle you can think of on your car. For example, our Ford Taurus has an interesting curl on the trunk lip, but I was able to flush mount the Ham-10 and position the radiator vertically.

I found it a lot easier to work with this base than several other antennas I have tried. About the biggest difficulty in setting the antenna up is the angle.

Setting'er Up

To set up the antenna, I first had to loosen a set screw in the base. This allows the mount to float freely in its arc. The second step is installing the mount loosely on the trunk lip so that you can find the correct angle. And, when this is done, the next step is marking and removing the mount and positioning the base so that it is at the correct angle. In practice, I found it required a couple of tries before everything lined up correctly. In fact, once I did it, it was easy to repeat the process when I moved the mount. However, until I was familiar with the procedure, I thought I'd need as many arms as an octopus. Yet once the set screw is down and tight, you don't have to think about it anymore.

Dave Hallow KE9BD, designer of the Ham-10, with his product mounted on his car.

Easy TX Line Routing

The antenna is actually designed with ease of installation in mind. For example, most antennas come with PL-259 connectors installed. This makes it a bear, sometimes, getting the cable through small holes in bulkheads. Recall skinning your knuckles while trying to snake a piece of RG-58 through a bulkhead hole, containing what seem to be several dozen stiff wires, all bent on keeping you from achieving your aim? The Ham-10 has what seems to be a variation of an F-style connector in the end. Threaded, you insert it into the bottom of the PL-259, *after* you have snaked the cable through whatever bulkhead holes to get the coax into the passenger compartment. It makes it easier to snake the cable under moldings, making the cable installation neat and out of sight.

As was noted earlier, the matching coil is a large, barrel affair that sits beneath the radiator. The literature states that the the coil and its housing are manufactured, rather than handmade or turned.

I've had an 11 meter coil for about a decade, and it seems to work the few times a year I throw that particular radio and antenna combination into the car.

Off The Bail

The radiator is somewhat a departure from the norm. Rather than using a corona discharge ball or device at the tip, as do most other antenna manufacturers, American Antenna relies on a thick radiator. It is roughly ⅛" in diameter, with a rounded tip.

Tuning

Tuning was handled via a set screw and a wrench. The instructions advised inserting the radiator so it touched the bottom of the mount, and then backing it out about ¼". I did that, and the rig I used, a Clear Channel AR-3500 Ranger, worked well. I felt that was pretty good for tuning an antenna without a VSWR bridge. Yes, I did have one with me, but I wanted to see if the instructions were right, and if the information underlying them was valid, which it was. Then I connected the VSWR bridge and obtained the readings noted.

The Ham-10 tuned up easily and remained at better than 1.8:1 across the 10 meter band.

Power

American Antenna claims the Ham-10 will handle a kilowatt. I didn't test it, but, given the heft of the coil and housing, it's a reasonable bet. During my 100 watt testing, the base remained cool and the radiator also remained cool. I would think that things would heat up rapidly if you pushed the power to a kilowatt. I'd also suspect that the plastic housing might turn into something a little less rigid than it is at that kind of power for a continued length of time. It's reasonable to think, though, that for power levels up to about 300 watts the Ham-10 will do quite nicely.

I personally prefer not to run a kilowatt down RG-58. I suppose it's possible, but I wouldn't want to chance this combination on my rig. It is a good one for lower-power operation, but I prefer at least RG-8X for mobile high-power work.

Conclusion

If you're in the rapidly expanding army of 10-meter mobile enthusiasts, the Ham-10 is a good idea. It's an easy antenna to use and should give reliable performance for years. Just don't forget to mount it cleanly, and make sure the ground is good, and you're on your way to 10 meter fun. 73

Number 11 on your Feedback card

73 Review

by Gordon West WB6NOA

Magnus Mobile kW Amplifier

QRO for the road.

Magnus Electronics
7101 Ridgeway Avenue
Lincolnwood, IL 60645
PH: 312-690-3205
Price Class: $1000

Looking for some additional kick to your mobile, mobile marine, or mobile home HF installation? If you've got an antenna system that can take it, the Magnus MA-1000B mobile amplifier "brick" will deliver a 2–30 MHz signal well above 600 Watts output!

The Magnus amplifier has been around for some time. I remember it as the "Mectron," originally produced by Trans World Radio in Escondido, California. I was always fascinated by its capabilities—100 Watts in, 600-plus Watts out! Completely broadbanded and all solid-state, its most exciting feature was 12 volt operation.

After a few months of hibernation, this amplifier has now reappeared under the "Metron" name, and is available from leading amateur radio dealers throughout the country. My unit was purchased from EGE when I was working next to them at our Radio School in Boxboro, Massachusetts. The amplifier is manufactured by Magnus Electronics. They don't sell direct; the amplifier is available only through authorized ham dealers.

Description and Specifications

This amplifier weighs 18 pounds and measures 4 inches high, 10 inches wide, and 18-½ inches long. It's designed for trunk-mounting with full remote control capabilities. Positive and negative studs with wing-nuts allow for immediate 12 volt DC hookup. The unit should be placed extremely close to a battery or a battery selector switch. For this amp, use the same wires that start your car. It draws up to 75 amps at 12 volts DC on voice peaks. There will be a significant power loss if you run anything smaller than #4 cable at any distance.

A common SO-239 antenna jack runs the output to your HF antenna system. If you're running mobile resonators, make absolutely sure you have the kilowatt coils. The 600 Watts of output will melt down anything smaller. Also make absolutely sure that any antenna system with this type of power on it can't be touched by anyone on the ground.

Also on the back of the unit is a multi-pin jack and a plug that allows for remote bandswitching. This amplifier is completely broadbanded, but each meter band must be selected in order to pull in the appropriate harmonic filters. For base station use, the remote control socket does select the bands of operation right on the front panel.

The best news is that the filter combination does not preclude the operation on any general group of frequencies in an emergency, such as marine frequencies. As you can see by the low-pass ranges, there is uninterrupted coverage from 1.8 MHz through 21.450 MHz. You may also extend the coverage up to 10 meters, or 29.7 MHz, with the optional ham-installed 10 meter add-on kit. More about that later.

The 5-Pole Tchebycheff Low-Pass Ranges

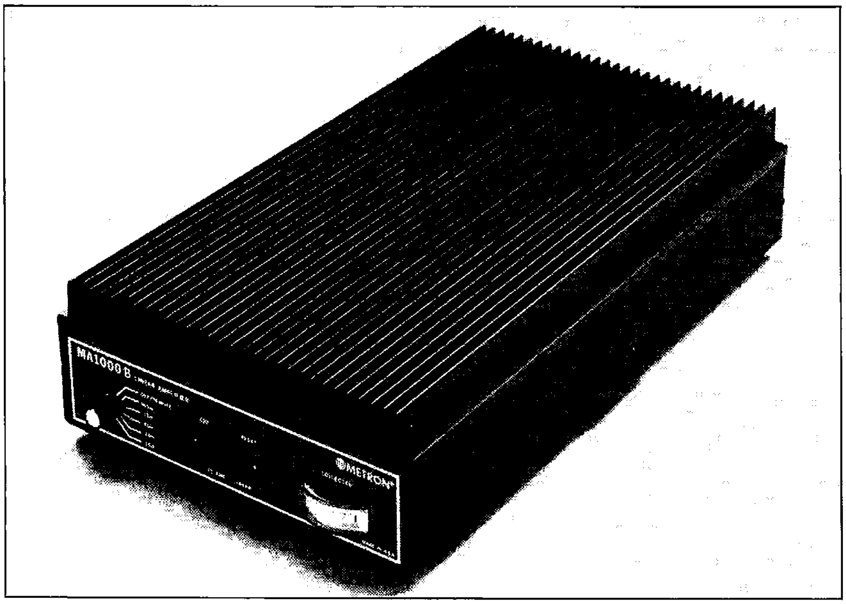
160m	1.8–2.0 MHz
75m	2.0–4.0 MHz
40m	4.0–7.5 MHz
20m	7.5–14.5 MHz
15m	14.5–21.5 MHz

There is also a pin that needs to be grounded to toggle the amplifier to transmit. This keying line is switched on by grounding the control line. You can switch the control line by using the exciter control relay built into almost every HF transceiver available today. You can also switch the amp completely off by using the circuit breaker on the front panel or, for remote control, by grounding the control line pin on the amplifier's rear contact. I measured 50 mA when the amplifier had been left on continuously. You can hear a couple of relays pull in when the amplifier is ready to go.

Construction

The front of the amplifier looks clean. It has a simple panel meter, 100 amps full scale, monitoring the collector current. This gives you an accurate monitor of amplifier performance, provided the amplifier is operated into the correctly matched load. There is also a high-speed, 75 amp magnetic circuit breaker on the front line. This circuit breaker immediately pops open if you try to overdrive the amp, or drive the amp on any ham band that you have not selected with the filter network.

An SO-239 on the back of the amp ties power output from your HF transceiver to the amplifier input. The amp likes to see about 75 Watts PEP input. Most HF solid-state transceivers will work nicely with the amp without any power changes. However, if you have fiddled with the ALC on your HF



The Magnus MA1000B mobile linear amplifier.

transceiver for more power output, you may want to cut your transceiver back to no more than 75 Watts PEP so you won't overdrive the amp and trip the breaker. We found that a constant breaker trip usually means that too hefty a signal has been sent into the amp.

The amp also shut down when we exceeded 75 degrees transistor heat sink temperature. It took me almost an hour with voice into a dummy load before this occurred!

The heat sink is on the top of the amp and forms the top of the chassis, which is constructed of 0.090 aluminum and is bolted to the heat sink. The entire amplifier is heatsinked, and finished in an attractive hardwearing black anodizing. We judged the construction of the amplifier to be "excellent."

The 10 Meter Kit

I also added the 10 meter kit. Unless you like working on these projects, pay the price and let the dealer do it for you. While it's not a tough job, you have to really strip down the amplifier to get at the filter board so you can remove capacitors and toroids and add new capacitors and inductors. You need a big soldering iron for this job, and you also need to know what you're doing when it comes to mounting electronics on a printed circuit board. The 10 meter kit instructions are fairly well-written, although they instruct you to remove some capacitors that aren't even on the PC board.

After a few hours, the modification for 10 meters was complete. Now the unit covers from 1.8 MHz all the way through 29.7 MHz. With 75 Watts of PEP drive power, I measured over 640 Watts of PEP power output with an in-line Bird wattmeter. We double-checked our readings with a B&W Model 334A wattmeter and dummy load. Same thing: much better than 640 Watts out. It wasn't long before the red overheat warning light of our dummy load and wattmeter started blinking, indicating that there was plenty of power coming out of this amp.

The MA-1000B is rated at a power input of 1,000 Watts to the eight power transistors operating as four push-pull amplifiers. The transistors use an emitter-ballasted chip design to control impedance and gain over a bandwidth of more than a decade. The amplifier operates Class AB with a computer-designed input network using a combination of inductors, resistors, and capacitors to provide a low input VSWR and substantially level gain across the operating range.

The broadbanded transistor amplifier has a relatively high level of harmonic output, but the even-order harmonics tend to balance in the push-pull output transformers, and the odd-order harmonics are not attenuated. A filter is essential to insure satisfactory spectral purity. The filter design used is a low-loss, 5-pole, Tchebycheff with a low reflection coefficient. We looked at our output on a spectrum analyzer, and harmonics were well within legal limits: down a measured −55 dB. Relays are employed at the input and output of each filter so that you may select the filters by remote control, or off the front panel.

The MA-1000B in Action

On-the-air reports indicate smooth-sounding audio. This is an important consideration. Many times solid-state, broadbanded amplifiers tend to make transmitted audio sound harsh. No such reports on the MA-1000B.

We operated the set maritime mobile into a kilowatt MFJ tuner. Again, results were excellent. When we switched the amplifier on, our signal strength rose by several S-units, and everybody commented on the exceptional "talk power," as well as the relative increase in signal strength. We hooked up with one station for approximately one hour, and then felt the fins of the amplifier. It was relatively warm, but not hot. Power still continued to exceed 600 Watts PEP output with less than 75 Watts power input drive.

We tried the amplifier in a vehicle on several mobile whips that were NOT rated at a kW. We found that we could talk for about 25 seconds before the whips would zap and give up the ghost. This was an interesting test. It drove home the point that most mobile whip antennas not rated at a kW simply can't handle 600 Watts of PEP output.

Be Safe!

WARNING: Observe great caution when operating maximum output, whether from a mobile at rest or in motion. This type of power could cause severe RFI into the electronic ignition system of some vehicles. It also poses a dangerous level of power around passersby, who sometimes touch antennas as they walk by. Anyone touching the antenna during voice peaks will receive, at the very least, a nasty RF burn. Observe the same caution with dipoles in trees. 600 Watts is enough to light almost any type of tree on fire, if the branches or leaves come in contact with the wire.

It's also a good idea to watch your battery. Although the 75 amp peak occurs only on modulation peaks, it nonetheless will kill a battery in about three hours of constant talking. After a longwinded conversation, we still had enough power to start our engine, but it didn't spin over like it normally does when the battery is full. Also, feel your battery leads with the MA-1000B drawing current. If they're getting warm, you may need to switch to a larger diameter cable.

Manual

We were impressed with the MA-1000B's instruction manual. It's technical enough to give you plenty of information about running the amplifier, knowing your amplifier, and, if need be, routine servicing of the amplifier.

The 10 meter add-on kit is available to all licensed hams. This hand-drawn set of information sheets, along with a bag full of components, is written relatively well, but the quality of the reproduction could be improved for greater legibility.

If you're looking for 600 Watts out, and want to run it off 12 volts DC, and you want complete band coverage from 1.8 MHz through 29.7 MHz, consider the Metron solid-state, 12 volt, DC linear amplifier. It's priced right at less than $1.50/watt output, and it's a terrific mobile performer.

Number 12 on your Feedback card

73 Review by Chet Lambert W4WDR

The Pro-67 HF Antenna

Be QRO without an amp with this antenna.

Mosley Electronics, Inc
1344 Baur Blvd. St.
St. Louis, MO 63132
(319) 994-7872
(800) 325-4016
Price Class: $830

Although I'm not lucky enough to have a laboratory to back up my research on the Pro-67, I have good old down-to-earth everyday use. Most hams, however, find an "operational" review sufficient for their needs.

What It Is

The Mosley Pro-67 antenna is a 7-element, 6-band antenna. The Pro-57 is a sister antenna, with 7 elements and 5 bands. The only difference between them is that 40 meters is added to the Pro-67. Both have a two-year warranty.

All seven elements (average wall thickness is 0.058") fit on a 2" x 0.125" 24' boom. The boom doesn't require any additional support. The elements, made of stainless steel, are heavy-duty. The only elements that sag are the two 42½-foot long driven elements.

There are three wide-spaced elements on 20 and 15 meters. Ten meters has four wide-spaced elements. There are three elements on 12 and 17 meters. Forty meters has two elements.

Putting It All Together

Pro-67 assembly went very smoothly. Charles Spanos N4DKE and his brother Michael KA4VCA put it together (see Photo B). They gave me just enough work to do to make me think I was a help. My greatest contribution was to provide plenty of ice tea. . . and to keep out of their way.

Here, as in most cases, it's a good idea to first thoroughly read the manual. Also, we found out the hard way that we needed PLENTY of room to move around in when putting together the Pro-67. I made do by putting some of the longer elements into our garage.

Check the parts to be sure you have everything the manual calls for (see Photo A). Don't worry too much about the screws, bolts, and nuts. There are extras, for people like me, who keep forgetting just where he put them—then finds them with his foot, scattering them like a meteor shower.

Put the pieces for each element in a separate pile (don't worry, they're color-coded). Put the boom pieces together, which are also color-coded.

Lay out the elements in the position they will take on the boom.

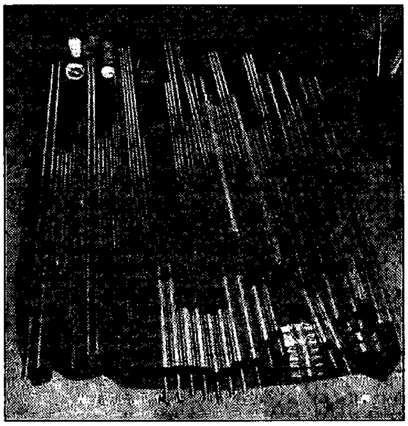


Photo A. Pre-assembly check. Make sure you have all the parts listed in the manual. [Photo by David Reasoner N4KTY.]

Take care with the traps placement. They are color-coded on one end only! Place the color-coded end nearest to the boom. A reversal of the traps will cause high SWR (standing wave ratio) and could affect other workings of the beam.

The only measuring needed was to check distances between elements on the boom. The element pieces themselves are pre-cut and pre-drilled as well as color-coded. All we had to do was match colors, align holes, and screw everything together. The boom is color-coded to assist with element placement. I recommend, however, getting exact measurements for best results.

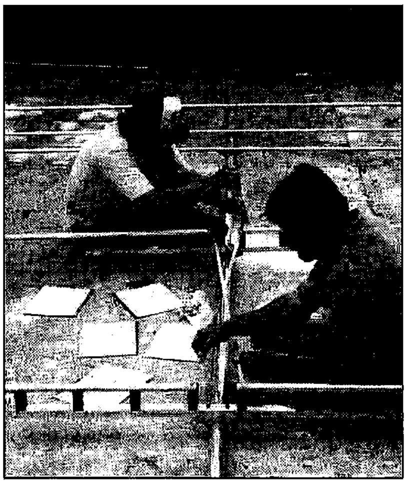


Photo B. Charles Spanos N4DKE and his brother Michael KA4VCA put the Pro-67 together. [Photo by Christie Lambert.]

One of the main strengths of the Pro-67 is the way the elements go together. The machined elements fit so closely it would be difficult to get even a hair between the pieces. Also, the portions of the elements and booms sections that fit inside their adjoining sections are very long. They are so long, in fact, that they meet the end of the inside portion of the section that fits in the other side of the adjoining section. This make the antenna virtually double-strength! This is the other main factor for minimal element sagging. It's common for beams to have only a foot or so overlap.

Assembly Time

The instructions give a 2½ to 4 hour assembly time. It took us one day. We took, however, extraordinary preventative measures. Charles N4DKE didn't want to put Penetrox (an anti-corrosion compound) to prevent the development of high resistance and seizing of the aluminum on just parts of the antenna; he had to have us take each coil apart and put Penetrox everywhere there was metal-to-metal contact within the coil (see Photo C).

The last thing we did before we raised the beam was to coat it thoroughly with Mosley Weather-Guard® antenna coating. I recommend buying at least one can with the antenna. This will give at least one coat on the antenna. The instructions on the can say it will dry in twenty minutes, but I made sure and let mine dry much longer. These extra steps took time but the time was well worth the effort. Follow the directions carefully; do not apply the coating to plastic parts.

Mounting the Antenna

I mounted my Pro-67 on my 90'+ Rohn 25G tower. I recommend, however, a tower at least as heavy-duty as the Rohn 45G.

Several Nit-Picks

The instructions I got were about a dozen and a half pages, which appeared to be photo-

copies. I have since then received a final set of twenty-seven pages that were more professional looking, especially the diagrams. Although the new set was better, I feel they could still be improved with desktop publishing.

Combining the instructions for both the Pro-67 and the Pro-57 is a little confusing, since the assembly steps regularly differ for the two beams. Mosley would do well to to print a separate set of instructions for each antenna.

One other thing I didn't agree on was the first step of assembly. That was the placing of the phasing lines to the elements. It is difficult to understand this without seeing the results. Doing it their way, there's a stage of very weak physical stability in the antenna. I feel this could be easier done as one of the last steps when there is more stability by having the boom and elements forming one strong unit.

Dave Reasoner N4KTY of Huntsville made a slight modification on the attachment of the metal strips to the SO-239 point (see Photo D). Dave added a second ground strip, the new one going from one of the elements to one of the mounting screws for the SO-239 connector. Other than the above, the antenna went together as Mosley said it would.

Photo C. Charles N4DKE insisted we put Penetrox not only on the aluminum parts, but everywhere there was metal-to-metal contact. [Photo by author.]

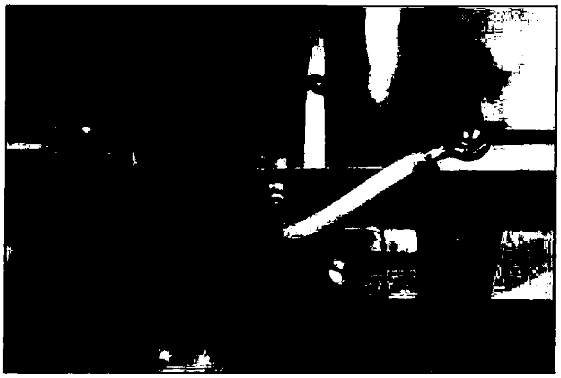


Photo D. Dave Reasoner N4KTY of Huntsville made a slight modification on the attaching of the metal strips to the SO-239 point. [Photo by N4KTY.]

Up and Going

This was the most difficult task of the entire project. Our lot is fairly small, we had a lot of trees, (at least in the wrong places), and the tower guys were also a hindrance. I at least had a full crew of able-bodied people to help: Charles N4DKE, Mike KA4VCA, Paul N4JTD, Teenie WA4REL (my XYL), Christie (my daughter), Kerry (my son), and my neighbor LeRoy.

PERFORMANCE

SWR

Here, I found a discrepancy in the paperwork that came with the Pro-67. The SWR (Standing Wave Ratio) charts showed more SWR than I got from using a Daiwa CN-520 SWR/Power meter. My highest SWR is on 40 meters, where at one point it is 2:1. All other readings are less than that, and at times, below those stated by Mosley. (See table below.)

Manufacturer's Specifications

Band (Meters)	Claimed Forward Gain (dBd)
10	10.9
12	6.0
15	8.9
17	6.9
20	8.5
40	3.5

Make Sure It's Aimed!

I was impressed with the Pro-67's front-to-back ratios. Recently, one night after midnight, I turned on my ICOM IC-751 and began tuning around. Twenty meters seemed abnormally quiet for that time of night, especially given the fabulous conditions on HF for the past few months. Ten and 15 meters weren't any better. I soon gave up and headed for bed.

Frequency (MHz)	SWR
7.0	1.55:1
7.15	1.1:1
7.3	1.55:1
14.0	1.4:1
14.175	1.1:1
14.35	1.4:1
21.0	1.25:1
21.3	1:1
21.45	1.2:1
24.5	1.45:1
24.7	1.6:1
25.0	1.3:1
28.0	1.35:1
28.25	1.1:1
28.5	1.1:1
29.0	1.2:1

Table 1. Observed SWR for the Pro-67 Antenna System. SWR meter was a Daiwa CN-520.

After turning out the lights, I started to leave the room; however, I noticed I'd left my Tailtwister™ rotor control box on. (I had Mosley's Pro-Search to modify it to an LED (light emitting diode) readout. A smart move. . .) When I went over to turn it off, I noticed it was setting on 37 degrees, which is where I normally work European stations. On a hunch, I turned on both my 751 and control box, turned the Pro-67 toward the South Pacific, and found the band wide open. I worked several countries. After making a few contacts, I turned the antenna back to the European countries—again, the band appeared dead. This little event showed me that the Pro-67 has a much better than average front-to-back ratio for its class.

In Sum

I was *very* impressed with the Pro-67. Of the several dozen beams I've erected in my 27 years of hamming, this was by far the easiest beam I've put together. Its performance, too, was outstanding. Using the Pro-67 with my ICOM 751 transceiver and 2KL (500 watt) amplifier, I received great reports from many DX stations. Many told me my signal was "the strongest signal I heard today," and "the only stateside station I can hear." A few days after I got the antenna on the air, my log looked like a DXCC listing. With about 18 hours of operating, I logged 38 countries, including Meralda VR6FWK (Pitcairn Island), Ken HB0/DA1WA (Leichtenstein), Mohammed 9K2MQ (Kuwait), and Paul 4X6UU of the Natanya Island DXpedition. For those with limited power out and a bit of a space crunch (i.e. no room for more than one tower), I highly recommend the Pro-67! 73

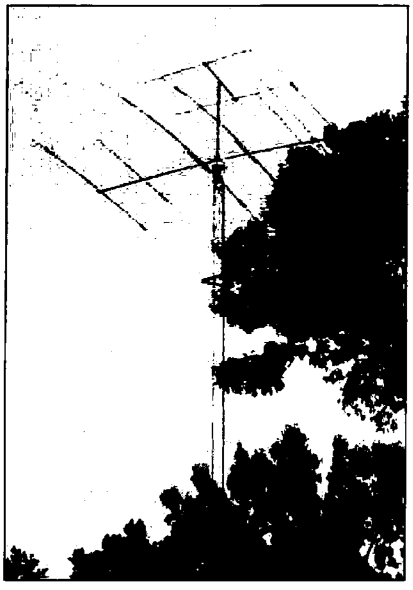


Photo E. The installed Pro-67, ready for action. [Photo by author.]

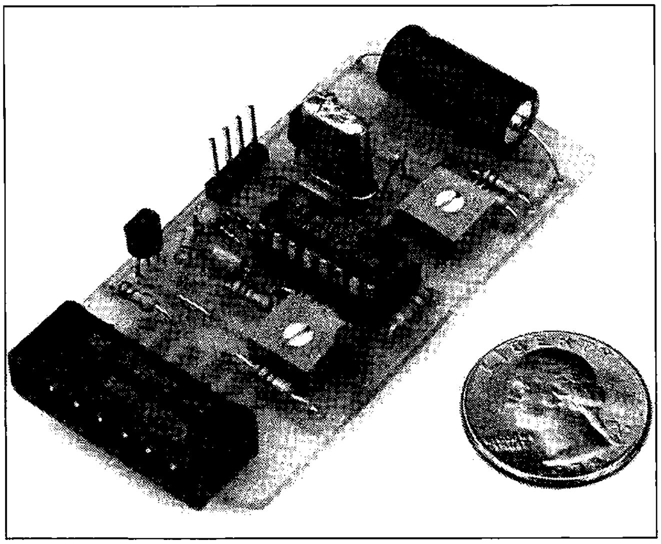
TCM 3105 Modem for the Digicom > 64

A mini-modem for 1200 Baud packet.

by Craig Rader N4PLK, John Krohn KJ4GP, Sam Baine W4KUM, and Mike Zinicoia WD4PVS

Another modem for the Digicom > 64 TNC Emulator program? Yes! This one is different from Barry W2UP's packet modem (see the August 1988 issue of *73*) in that it works exclusively on 10 meters, VHF, and UHF at 1200 baud. It's cheap and very small —so small, in fact, that some Digicom enthusiasts are installing this little jewel *inside* their Commodores!

The prime mover of this simple modem is a single 16-pin modem IC, the TCM 3105, manufactured by Texas Instruments. This IC, powered by 5 volts, handles all modulation/demodulation functions digitally. You can attach it directly to the cassette port of the Commodore 64 and 128. Because the TCM 3105 consumes little power, you may operate other programs and peripherals concurrently.



Get on 1200 KB packet with this little gem.

Get on 2 Meters Quickly and Cheaply

If you have operated HF packet, you know that the mode is difficult even with expensive interfaces. A tuning aid, such as an oscilloscope or LED bar graph, is necessary. Sophisticated filtering, such as that found in expensive modems, is also desirable. If you're a newcomer to packet, you may not want to get involved in all that at first. For packet newcomers, 2-meters is the place to start, and this modem will get you on there quickly and cheaply.

The idea for this modem came originally from the West German authors of Digicom. In their German program documentation, we include a basic, hand-drawn schematic. Over time, as a result of use and testing, we made additions and modifications. For example, we added front-end audio limiting and a watchdog timer. With the aid of applications engineers at Texas Instruments, they made several circuit modifications to improve the modem's sensitivity.

We came up with the following PC board and construction design to make the Digicom program more accessible to people. We hope that the low cost and ease of construction will encourage more newcomers to join the packet mode.

Assembly

The component layout diagram (Figure 2) shows the PC board parts mounted as they appear on the non-foil side of the board. Hold the PC board up to a light to see the foil traces on the opposite side, and use these traces to guide you in parts placement.

The design uses a right-angle, six-contact card-edge connector (Dale EBT156-6R1W). It's possible to use a regular solder tail connector, as the solder points will line up the bar traces on the PC board. Apply a thick line of plastic cement to the board/connector joint in this case, to prevent the solder tails from breaking off. The PC card is installed in the Commodore's cassette port, *foil side down*.

Note carefully the orientation of the IC and ensure that the IC socket is soldered correctly for proper orientation of the chip. Do not install the IC until soldering is complete and the board has been tested for shorts.

When assembly is complete (and before installing the IC), make a continuity check between pin 2(B) of the cassette port connector and the other pins. As you look straight at the computer side of the connector, with the non-foil side of the PC board up, pin 1(A) is at your right and pin 6(F) is at your left. With R9 turned fully counterclockwise, there should be at least 100kΩ between pin B and the other pins. If there is less resistance, you have a solder bridge somewhere. Check the entire PC card carefully for solid solder connections and solder bridges.

You will need to make four connections to your transceiver: push-to-talk, microphone, speaker (audio from the transceiver), and ground. You're lucky if you can get audio from the front panel of the rig (as in the new ICOM models) because then you'll need only one cable. If you can get audio only from a separate jack on the rig, then you'll need a separate cable. Join the ground from the audio line with the ground from the MIC/PTT line at the PC card.

If you use an HT with this modem and the HT's PTT circuit is combined with the MIC circuit, then join the two lines from the modem before they reach the jack on the HT. This is normally done with a resistor in the PTT line and a 0.1µF capacitor in the MIC line. The value of the resistor varies with the brand, but 3.3kΩ works with the Yaesu and 30kΩ with the ICOM. If you have a friend

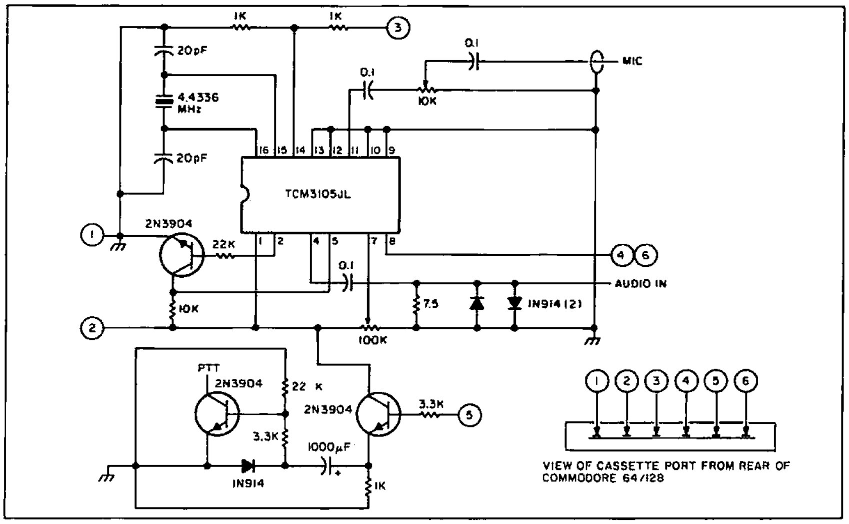


Figure 1. Schematic for the plug-in modem for Digicom > 64.

with a TNC, ask him what the directions say for connecting your brand of HT to his TNC. Whatever works for TNCs will work for this modem.

There are some transceivers, particularly those with PTT relays, that won't key up with a small transistor like the one used on the modem board. If you have such a transceiver, you could insert an opto-isolator, such as a TIL-119, in the circuit. This low-cost, 6-pin IC will key transceivers with PTT voltages as great as 100.

Pinout for the TIL-119

1. Connect to pin 2 of the cassette port (5 volts) through a 3.3kΩ resistor.
2. Connect to the PTT pin on the modem header.
3. No connection.
4. Connect to negative side of transceiver PTT circuit.
5. Connect to positive side of transceiver PTT circuit.
6. No connection.

Tuning and Testing

Install the IC chip, correctly positioned, into its socket and install the modem into the cassette port while the computer is off. Turn the computer on and feel the IC chip. If it is warm at all, turn off the power and remove the modem from the cassette port. Recheck the modem for IC orientation, solder bridges, and incomplete connections.

R9 adjusts the receive bias of the TCM 3105JL. The quickest and easiest way to make this adjustment is to boot up the Digicom program when the packet frequency is busy, and adjust R9 until Digicom starts printing data. Of course, you must have the monitor functions of the program turned on. Alternatively, you can adjust R9 for the presence of the correct voltage on pin 7 of the IC chip. With 5 volts applied to the modem, R9 should decode when 2.26 volts are present at pin 7. Digicom doesn't have to be running, but be careful not to short adjacent pins with the voltmeter probe.

R4 controls the AFSK audio output from the modem to the MIC input of your transceiver. You don't want to overdrive your rig so adjust it for the minimum output that will give reliable reception. Send UNPROTO packets via a local digipeater and watch your screen. If you see your rig transmitting, but the digi is not repeating your data, you know the output is too low.

A 30-second watchdog timer incorporated in the modem design should be adequate for any packet transmissions. If longer time-out periods are desired, you may increase the value of C6. However, remember that the sole function of this timer is to drop out the PTT circuit if it is accidentally keyed while you are not present. The longer the time-out period, the greater the chance of frying your rig. Be conservative and go with the shortest time-out period.

Parts Availability

The following distributor is given as a source for the TCM 3105JL modem IC, the 4.4336-MHz crystal, and the 6-pin (double) card-edge connector, although other distributors carry the parts: *Active Electronics, 133 Flanders Road, Westboro MA 01581; 1-800-228-4834.*

Complete kits will be available at the price of $38.50 plus postage (US and Canada, $2.50; other countries, $5.00). These kits will include a high-quality printed circuit board and all components necessary to get the modem on the air, excluding the transceiver cable. Money orders in US currency only, please. Contact *Craig Rader, N4PLK, 922 Baltimore Drive, Orlando FL 32810-5531.*

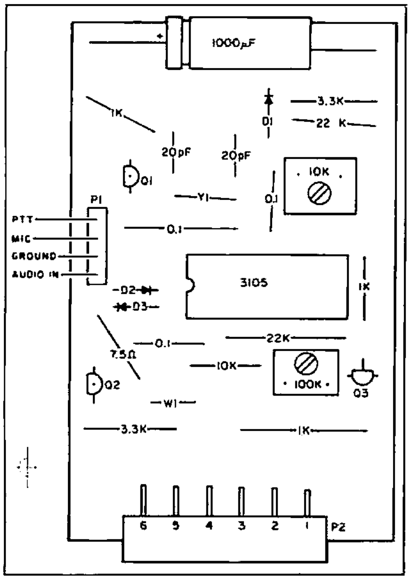


Figure 2. Parts placement diagram.

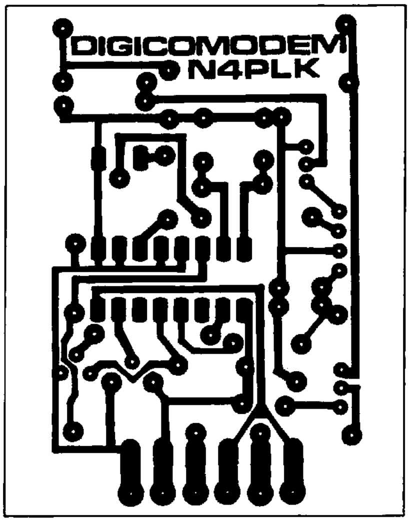


Figure 3. Etching pattern for the PC board.

Parts List

Resistors

R1	1k	R7	10k
R2	3.3k	R8	22k
R3	220k	R9	100k single-turn pot
R4	10k	R10	1k single-turn pot
R5	1k	R11	3.3k
R6	7.5Ω		

Capacitors
Poly, Mylar, or tantalum

C1	20pF	C4	0.1µF
C2	20pF	C5	0.1µF
C3	0.1µF	C6	1000µF (electrolytic)

Other

D1, D2, D3 1N914 diodes
Y1 4.4336 MHz HC-18 case crystal
Q1, Q2, Q3 2N3904 NPN transistors
U1 TCM 3105JL FSK Modem IC
P1 4-pin header (0.1″ spacing)
P2 6-pin card-edge connector (Dale EBT156-6R1W)
W1 wire jumper
16-pin IC socket (PC mount)
Case (if desired)
4-conductor shielded transceiver cable
Audio cable (if required)

Number 14 on your Feedback card

73 Review

by Bill Clarke WA4BLC

ICOM IC-2GAT

Successor to the workhorse 2AT.

ICOM America, Inc.
2380 116th Ave., NE
Bellevue, WA 98004
206-454-7619
Price Class: $429

Over the years many 2 meter HTs have come and gone, yet one has become an accepted workhorse: the ICOM-2A(T). It is a simple, rugged, inexpensive unit that you can rely on to work every time you need It. However, the venerable 2AT is limited to one frequency at a time, thumb wheels for changing that frequency, and no bells and whistles. Enter the IC-2GA(T), ICOM's updated workhorse.

The 2GAT is slightly smaller than its predecessor, yet bears some resemblance to it. Perhaps the most important similarity is that all your old ICOM battery packs will function with the 2GAT. No need to buy extra packs or a new charger when you upgrade within the standard size ICOM HTs (2A/3A/4A, 02AT/03AT/04AT, marine, commercial, and aviation). I appreciate this because I have a box of ICOM batteries and an ICOM charger. They represent an investment that I don't want to replace just for the sake of an equipment upgrade.

No More Thumbwheels

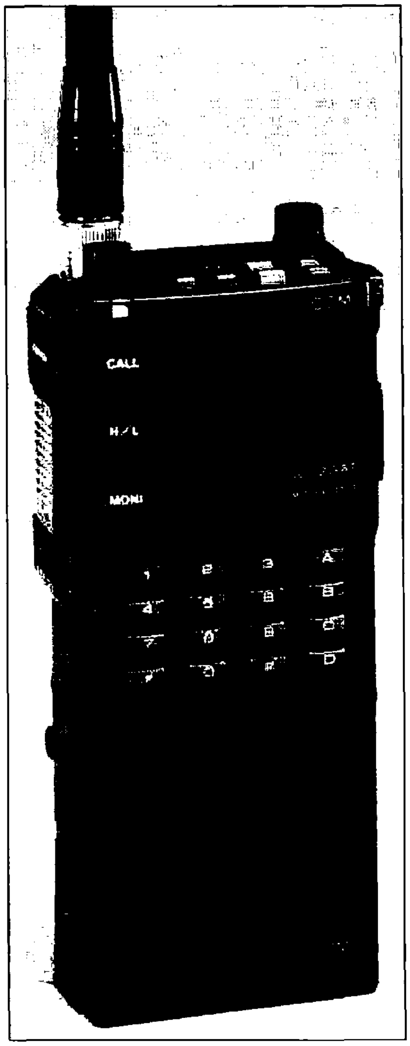
Gone are the famous thumbwheels used for frequency changes. In their place are little rocker switches. They are aligned like the old wheels: MHz/100 kHz/10 kHz. The last rocker (10 kHz) is programmable for step sizes from 5 to 25 kHz. On the top, just above the rocker switches, is an LCD digital display which shows the frequency and various functions. All switching is done from the front or top of the unit; no more looking on the back for switches.

Those of you familiar with ICOM's 02AT series will find the function switch in its familiar location (left side above the PTT switch). The function switch allows many single controls to have more than one function.

The 2GAT isn't a micro-sized radio, but it is not large, either. The automobile makers' phrase "mid-size" seems appropriate for this HT. Its handy size permits controls that are easier to see and use than those found on the micro-size HTs. With the BP-70 standard battery pack attached, I can use my old leather case from the 2AT. This pleases me because the case is hand-made and has my call on it.

Impressions

When I found that I could do simple operations with it even before reading the instruction manual, the 2GAT made an immediate good impression on me. However, for more than just this, reading the manual is required.



The 2GAT has all the HT features considered standard:

- •High power—7 Watts (max).
- •Water resistant—can get damp in the rain (but don't take it swimming).
- •Power saver—reduces battery drain during "no signal" conditions.
- •Two types of scan—program and memory lock-out.
- •Monitor—opens the squelch with the push of a button.
- •Pocket beep—works similar to a pocket pager by using the optional UT-40 Tone Squelch Unit.
- •Battery condition indicator—for battery monitoring.
- •Batteries—available from 270 mAh to 800 mAh (I prefer the smaller size, to keep the physical package small).
- •Extended receiving—covers portions of the public service bands (police, fire, marine, and weather).

Observations

The 2GAT is very comfortable to hold. Although I like the small size of the micro-sized HTs, this new radio allows better physical use of the radio's controls. I did, however, find that the rocker and push switches are very sensitive and that it is easy to make them stutter.

The audio from the 2GAT is adequate for most uses. It is certainly an improvement over the low audio power of the 02AT.

The 2GAT provides a beep whenever a switch is used. The beep can be silenced if desired.

The LCD display can be lighted at the push of a switch. After a few seconds the light will go out, saving valuable battery power.

Programming the memories with my favorite repeaters, NOAA Weather and a couple of local public service frequencies, took a total of ten minutes. Not bad for a first attempt.

I really enjoy the capabilities of this HT's receiver. The ability to monitor local public service, marine, weather, etc. is a nice addition to the standard 2 meter band.

The tuning step-size is selectable. It affects the scanning steps and the size of the up/down jump that the third frequency rocker switch will make. For my uses I found 5 kHz to be adequate for both portions of the 2 meter band and for public service. For the latter, 25 kHz would also work fine.

From time-to-time I operate on a repeater that uses a split of 1300 kHz. This presents no problem for the 2GAT. It accepts anything you program into it.

When using memory scan, you can lock out channels that you don't want to listen to. This is a very handy feature. I use it to lock out heavily-used repeaters when I am listening to the public service band.

Band scanning is programmed by setting the band edges (upper/lower limits) of the planned scan.

As on the 02AT, there is a lock function that effectively shuts off all of the switches. This means that you cannot bump a control and accidentally wander off into never-never land.

The CPU can be reset without opening the

case or having to intrude into the case with a paper clip.

I did not review the UT-40 tone squelch unit, which allows the radio to work like a pager. The idea sounds useful and I plan to make use of it in the future.

Due to the complexity of the 2GAT, I would recommend you practice using its features from time to time. Otherwise, you will find yourself reading the instruction manual each time you want to use the HT. I don't think that this suggestion is very uncommon in today's world of flashy gadgets.

Overall, I gave the 2GAT high marks and recommend it as an affordable, yet complete, 2 meter HT. Its size, weight, capabilities, and transmitter power make it a very desirable package.

"Gone are the famous thumbwheels used for frequency changes."

Bench Check

The 2GAT was bench-checked and found to meet, or exceed, all of the published specifications. As with most recent equipment, this is not spectacular. Only on rare occasions have I found a modern CPU-based communications device that failed to meet specs. Most exceed their published specifications.

Bench checks were made using the following equipment:

- Leader LDC 8243 Frequency Counter
- Marconi Instruments 2022 Signal Generator
- Bird 43 Wattmeter
- Hewlett Packard Spectrum Analyzer
- Cushman CE-5 Monitor

Accessories

ICOM provides a complete line of accessories for the IC-2GAT, including a drop-in charger, assorted battery packs, tone decoder, speaker microphone, headset, VOX unit, and leather carrying cases.

Thanks to the Electronic Equipment Bank, 516 Mill Street, Vienna, Virginia 22180 (1-800-368-3270) for the use of their superb test facility. ■

Specifications for the IC-2GAT

General Frequency Range	144 to 148 MHz transmit 138.00 to 174.00 MHz receive	Weight	1.1 lbs. (w/BP-70)
Mode	FM (F3)	Transmitter output power	7.0 W (high power) 1.0 W (low power)
Memory channels	21 (20 regular & 1 call)	Deviation	+/−5 kHz
Frequency step	5, 10, 15, 20, 25 kHz (selectable)	Spurious radiation	less than −60 dB
Antenna impedance	50Ω	Receiver circuitry	Double conversion superheterodyne
Power requirement	5.5 to 16 VDC	IF	16.9 MHz (1st IF) 455 kHz (2nd IF)
Current drain	Transmit 1.8 A (high power) 0.9 A (low power) Receive 0.25 A (maximum audio) 0.10 A (battery saver)	Sensitivity	less than 0.25 μV (12 dB SINAD)
		Spurious rejection	less than −60 dB
		Audio output	More than 400 mW at 10% distortion into an 8Ω load
Dimensions	2.6″ x 5.1″ x 1.4″ (w/BP-70)		

Number 15 on your Feedback card

73 Review *by Cortland Richmond KA5S*

Shirt Pocket ICF-SW1

How I put the world in my waistcoat for only $300

EGE
14803 Build America Dr.
Building B
Woodbridge, VA 22191
703-643-1063
Price Class: $285

In my pocket, briefcase, or even "velcro'd" to the dashboard, the Sony ICF-SW1 is a convenient, powerful all-band radio that should have been available years ago. It is what the ICF-2002 ought to have been. It is certainly hard to resist. I broke down and bought it after just three trips to the radio store. This is a report on my first 60 days using the tiny little set.

The SW1 is small, but the box it comes in is big. That's no deficiency, because the box holds not only the receiver, but also a power supply, earphones, an active antenna, and instruction books. The antenna alone is bigger than the receiver. For top-notch reception, using the active antenna and the AC power supply pulls in even weak stations. For portability, just slide the receiver into a shirt pocket and go. Both the active antenna and the radio are powered by internal batteries, but only the receiver may be run on the AC supply. This shouldn't be a problem. The earphones are (finally) good quality hi-fi "ear-buds" (all these years they sold us expensive radios with two-dollar earplugs) that can produce super sound, especially using the FM stereo mode. It's impressive, even if the earphones do keep falling out of your ears.

There's a soft fabric case for the radio set, but this fails as protection, since it quickly becomes a hassle to use. If you want to use the earphones, you'll find them in their own little reel-in box. It flips open, you unreel the cable and take them out. When finished, pop 'em back in and reel up the cord. No more tangled wires. To step up the audio, a pair of Radio Shack amplified speakers work great in the car, or portable in noisier environments, like the beach.

What about using this setup? Well, it isn't hard to figure out how it runs—Sony has accustomed us to their style with the 2001, 2002, 2003, and 2010. And you can always read the instructions. There's a slide switch for positive "off," so batteries won't be run down by accident. A push-button turns the power on and off: one push and it's on, another and it's off. The audio gain control is conveniently located on the back (if a half-inch-thick set even *has* a back), just where a right-handed person's thumb falls. Mine did, anyway. Tuning is done either with a keypad, or by using up/down buttons for the band and frequencies.

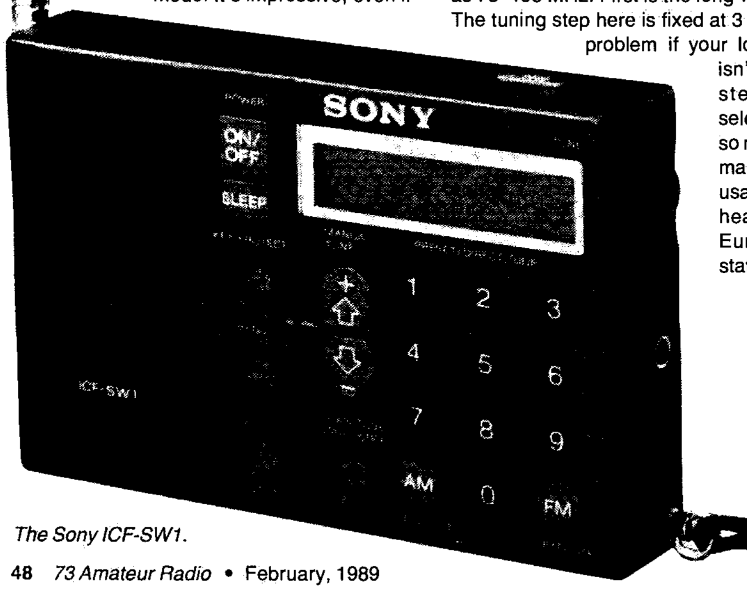
There are really four bands here, even though the SW1 tunes 0.15–30 MHz, as well as 76–108 MHz. First is the long-wave range. The tuning step here is fixed at 3 kHz. It's no problem if your local station isn't right on a step, as the selectivity isn't so narrow as to make this unusable. I have heard several European LW stations on my other equipment but could just barely detect the 2 MW giants with the SW1. Local navigational beacons are readable, but not very. The internal loopstick, after all, is just a few cm long. The active antenna didn't help me much here, either. Still, if I were in Europe, there'd be a multitude of LW broadcasters, all running high power, to fill the band.

The MW broadcast band is next, with either 9 kHz or 10 kHz tuning steps. Europeans use the narrower setting. Again, this is no problem, even if you're DXing, as the set has enough selectivity to be usable, but not so much that it's inconvenient. Performance on MW is somewhat better than on LW, with daytime reception of Boston stations 30 miles north of Beantown, at my work site in the wilds of New Hampshire. Nothing super, but certainly adequate. Strangely, the active antenna was worse than the built-in one.

It's on the SW bands that the SW1 shines. Despite an antenna just about a foot long, it still pulled in the regulars easily. The BBC (5975, 9410, 12095), Israel (7460, 9385, 9435, 15615), AFRTS (6030), Australia (9580)... all came booming in. Iran (9022) was unreadable, though the Iraqi jamming would probably have hashed it up pretty well, anyway. It looks like 2 kHz is a bit too far off frequency for peak performance. Or maybe it's just that I don't understand Farsi.

On SW, the SW1 tunes in 5 kHz steps. That's it. No fine tuning, and no wide or narrow selectivity, either. Well, it does fit in a shirt pocket. Within that limit, if I could hear something on my ICOM IC-735 (with 200-foot half-rhombic and Cushcraft R-3), I could hear it on the SW1. It wouldn't, perhaps, be as strong, or as readable, but I could hear and recognize it. And the active antenna made the SW1 even hotter than the receiver section of the IC-735. That says a lot.

What Sony has done for band selection is to put the bands into permanent memory. By clever use of three buttons at once, you can go up or down through



The Sony ICF-SW1.

the various bands, And they're all there, tropical, 75 meters, 21 meters, and 11 meters. You won't, however, find the 11-meter CB band programmed in. You can tune it and punch in frequencies manually, but you can't jump up to it with the "bandswitch" and you can't scan through it.

The scan feature is one feature Sony did well. Normally, scanning on an SW receiver is a bit of a waste. On the 2010, you can scan the memories, which makes that useful, but the frequency scan has to be set in two memories and doesn't seem to work that well when you do use it. The SW1 seems to have just the right combination of scan rate and selectivity to make it work. If I want to tune the band, I'll let it scan. If there's a strong signal, the radio will stop for a few seconds, then move on. Just enough time, if I'm quick, to stop the scan, but short enough to make it speedy. I don't miss the tuning knob at all. But if I am in a hurry, either the up or down arrows will make the set step right along.

Hear's To You

In a first for Sony SW travel radios, the SW1 has a good-quality earphone. It has even got stereo audio, for FM. But the FM band is disappointing due to the SW1's poor front-end and adjacent channel performance. The FM tuner is plagued by intermodulation from strong stations, even de-sensing when tuned too close to a local FM broadcaster. That's too bad, because the sound is excellent when you get out in the country. The stereo mode is automatically selected if the signal is strong enough. In an automobile, this results in the noise level going up and down unpredictably, which can be annoying. By the way, there isn't any external antenna connection. For the car, I clipped a coax onto the whip antenna's cap and grounded the coax to the "recorder" output jack.

That's how Sony does it, too. The active antenna (which does not cover FM) contains a coax, with a phone-plug on its end. You unreel this cable, but it doesn't plug into the radio. Instead, it goes to a control box. That plugs into the SW-1's recorder output jack. On the control box is an on/off switch, and a bandswitch for LW/MW-SW. How does it work?

The control box is more than that. It has a small ferrite loop, for coupling to the radio on LW and MW. The loop aligns with the internal one when the unit's clipped on. You'd get better reception if you held it against the radio's top edge, but not too much better. On SW, the antenna connects via a spring-loaded button to. . .the built-in whip. Clever. You don't lose the use of the recorder output, by the way, as it's brought through the coupling unit/control box. The on/off switch is nothing more than a DC circuit across the coax, letting current flow to run the remote antenna. If your other portable has DC continuity at its external antenna plug, this antenna will work with it. It did on my ICF-2010. Bear in mind that current will flow as long as it's plugged in, however.

Power drain is not bad, either. I have an ICF-2001 that ate batteries. This set uses two penlight batteries (get them in any drugstore) that last a week or more of heavy use. I haven't run down the antenna batteries—I hardly use it. Still, a trip to the Caribbean or Europe would probably only take one change of cells, and that's great. The 2001 would give me eight hours on three D-size alkalines.

Shortcomings

I didn't say anything about SSB and CW, did I? That's because the SW-1 doesn't have a BFO or a product detector. It's strictly for AM and FM broadcasting. No fine-tuning. Well, I don't know where they'd put it, actually. And without SSB or synchronous detection, who needs it? Most stations are within a kHz of the radio's channel. Actually, the worst shortcoming is the darned keypad. The numbers come off. Sony, why didn't you, when you were selling a $300 radio, at least use double injection molded keycaps? Pretty soon I'll have to paint new numbers on the buttons. And yes, I could have used that pretty little blue-gray fabric cover. But then I couldn't have used the radio like I do. Just whip it out, and. . .

"See folks, how easy shortwave radio is (punch punch). . . Voila: Jerusalem."

Getting High on Packet

Excellent advice for getting on HF packet.

by Brian Lloyd WB6RQN

Most hams operate packet radio on VHF and UHF frequencies, using NBFM radios modulated with Bell 202 compatible modems. Although inefficient, this simple technique allows almost anyone to put a reliable packet radio communications system on the air. The main drawback is that this mode is limited to short-range communications. Many hams may find it far too limiting, and choose HF operation to increase their communications range. However, HF packet operation is not nearly as simple as VHF packet. What are the pitfalls of HF packet operation, and how can you avoid them?

VHF packet uses the Bell 202 modem standard, which means that data is transmitted at 1200 baud, using mark and space tones of 1200 Hz and 2200 Hz, respectively. HF propagation, however, will not support a 1200-baud signaling rate. The current HF operation standard is FSK at 300 baud with a shift of 200 Hz. These operating parameters, and the characteristics of HF operation, create problems for the packeteer.

Packet Trade-Off

Packet radio transmits a Cyclical Redundancy Check (CRC) field at the end of every packet. This CRC allows the receiver to determine whether the packet is correct or whether it has errors. The receiver acknowledges good packets and rejects packets with errors. Even one bit in error will cause the receiver to reject the entire packet. Since there is a probability that a bit will be received in error, this can be a problem.

Let us assume that the rate of bit error is 1e−3 (1 times 10 to the −3 power, or 1 in 1000). This means that approximately one bit in every 1000 bits transmitted will be in error. If our packets are 1000 bits long, most of the packets will have errors. On the other hand, if we shorten our packets to 100 bits, the probability is that only about 10% of the packets will have errors. For this reason, short packets are more likely to be received without errors than long ones.

Unfortunately, you cannot arbitrarily send short packets. Each AX.25 packet contains at least 19 octets (19 eight-bit bytes) of control and formatting information other than the data you are sending. Therefore, you must transmit 152 bits of information in addition to your data. To send even one character (8 bits), you must send a total of 20 characters (160 bits) in the packet. So here we have the big trade-off: smaller packets are more likely to get through, but larger packets are going to give you much better throughput.

> ***"HF packet operation must take place near the MUF for reliable operation."***

In large packets, a greater proportion of the transmitted information is actual user data. Imagine how slow your progress would be if you sent only 20 characters in every packet just to transmit one character of data. You must strike a happy medium. The best value for packet size is a function of your particular station configuration and of the current propagation characteristics. Most HF packeteers seem to find that a packet-length (PACLEN) of 32 octets is a good starting point.

Multipath Propagation and Baud Rate

Propagation plays a very important role in effective HF packet operation. Strong signals, while desirable, are not sufficient to provide reliable communications (kicking in the amplifier is NOT a good solution unless you are trying to overcome QRN). Remember that the receiver discards the packet if even one bit is bad. You must make sure that the receiver can properly discern the bits as they are received.

When you operate well below the Maximum Usable Frequency (MUF), you begin to have problems with multipath, i.e., signals that take different paths and arrive at the receiver at different times. Multipath causes selective fading and "smearing" of the bits. If the signal changes very slowly, the different arrival times do not cause as much of a problem.

To avoid multipath problems, the military chose a 45.45 baud rate for their RTTY operations. A baud rate of 45 will work well from about one-third to one-half of the MUF. In HF packet operation, however, you are using 300 baud, and 300 baud will not work well in the presence of multipath. HF packet operation must take place near the MUF for reliable operation. If you are planning to operate HF packet all the time, you must be able to operate on ALL available bands from 80 meters to 10 meters.

Generating Packet Signals

There are many ways to generate the packet signal. Since packet, like RTTY, is FSK, you can use all the RTTY techniques. Direct FSK, frequency shift keying, is the most desirable technique. Many HF transmitters today offer direct FSK operation, but there is one caveat: most of these FSK modes are optimized for operation at 45 to 75 baud with a shift of 170 Hz.

To operate packet, you will need to adjust the transmitter so that it will generate a 200 Hz shift. You will also need to modify the FSK keying filter (the RTTY equivalent of the CW key click filter), which is a low-pass filter usually found somewhere in the FSK keying line. The standard filter has a cutoff frequency of about 100 Hz, and it will not pass a 300 baud signal. Modify it to a cutoff frequency of 400–600 Hz.

Once you have made the necessary changes, the FSK mode of your transmitter will generate a high quality FSK packet signal. Just take the digital data signal from the TNC ahead of the modem, and use it to

key the FSK line of the transmitter. If the transmitter doesn't accept a TTL level signal at the FSK input, use an appropriate level shifting and/or driver circuit (see the digital section of *The ARRL Handbook* for suggested driver and level shifting circuits).

If your rig does not have an FSK mode, or if you do not wish to adapt its FSK mode to packet operation, you can use AFSK. With AFSK, you feed the tones from the modem into the input of the SSB transmitter. For all purposes, the output is then FSK, or an F1B emission. When you attempt to generate an FSK signal with AFSK and an SSB transmitter, you must be very careful about transmitter linearity, modulating signal purity, carrier suppression, and unwanted sideband suppression.

HF Packet Signal Modulation

The modulating tones you choose are not critical as long as their frequency difference, or shift, is 200 Hz. Most SSB transmitters do not accept all tones equally. If you use a Bell 103 modem to generate the tones (2025 Hz and 2225 Hz), you may have a problem achieving full power output, or the power will differ between the two modulating tones. You can remedy this problem by using modulating tones which are closer to the center of the transmitter's passband. The most common tone-pair used in packet radio is 1600 Hz and 1800 Hz. For most SSB transmitters, these frequencies fall in the middle of the passband, where the the passband is flattest and the distortion is least. You can adjust most TAPR TNCs and their clones to generate these tones.

When you are using AFSK, the frequency display on the transmitter will not be accurate. Most RTTY and packet operation is lower sideband (LSB), which causes the transmitted signal to be lower than the transmitter's displayed frequency. To determine the actual transmit frequencies, you will have to add or subtract the tone frequencies from the transceiver's carrier. If you are using the standard 1600/1800 Hz modulating tones, and the transmitter is configured for LSB at 14108 kHz, your signals will end up on 14106.4 and 14106.2 kHz, respectively.

Remember that most HF transmitters are not rated for continuous operation at full power. If your transmitter is not rated for 100% duty cycle at full output, keep a close watch on the temperature in the PA. Although packet is not a continuous-operation mode, it can tax the average transmitter that is not rated for 100% duty cycle operation. Play it safe. Limit your transmitter to about half of its maximum rated power output for packet operation.

HF Packet Reception

HF packet receiving techniques are almost identical to HF RTTY receiving techniques. In almost all cases, an SSB receiver feeds audio frequency signals into a demodulator (terminal unit, or TU, in RTTY parlance). The demodulator identifies and extracts the bits for presentation to the digital circuitry of the TNC.

The first step toward achieving the best performance from your HF packet station is to pay attention to the radio part of packet radio. Simply attaching a TNC to an HF receiver, switching on LSB, and trying to copy packets, is likely to produce disappointing results. The first problem stems from the fact that most SSB receiving filters are far too wide, typically 2.1 to 2.5 kHz in bandwidth, for packet operation. Unwanted signals come into the passband and activate the receiver's AGC. Although your ear may not discern the change, your modem and TNC will. Most experienced HF packeteers have found that a 500 Hz CW filter is just about optimum for 300-baud HF packet with a 200 Hz shift.

It is very important to ensure that you get the tones in the center of the filter's passband. Most modern receivers have some sort of passband tuning (PBT) control that allows you to shift the filter relative to the BFO injection frequency. Use the PBT to center the tones in the filter's passband. If your receiver does not have a PBT control, you must tune the receiver to center the tones in the filter's passband, and adjust or modify the demodulator to accept the final tones.

"Most experienced HF packeteers have found that a 500 Hz CW filter is just about optimum for 300-baud HF packet with a 200 Hz shift."

You must have a tuning indicator that will allow you to tune the receiver EXACTLY. If you want your demodulator to work properly, you will need to tune the receiver to within 10–20 Hz of the transmitted signal. The performance of most demodulators falls off very rapidly as the receiver is detuned, so the receiver's stability in maintaining a frequency is very important.

With the proper filter in the receiver, and a properly tuned receiver, almost any demodulator will produce good results. Several manufacturers offer high performance demodulators that give better results than the simple demodulators provided with most TNCs. On the other hand, if you do not bother to tune carefully, and if you do not have a good 500 Hz filter, even a "super demodulator" is likely to perform more poorly than an inexpensive demodulator. Spend the money on the receiver first, then decide whether you need a super demodulator.

Operating Suggestions

HF packet is not easy to tune in. For this reason, many stations tend to congregate on just a few frequencies, and not everyone can hear everyone else. This causes Carrier Sense Multiple Access (CSMA) to break down, to everyone's detriment. Here are a couple of operating suggestions:

1. Don't try to access the long-haul bulletin boards. If you want to access a BBS, do it on VHF. Use HF packet for rag-chewing or exchanging data with your more distant friends. If there are no BBSs on VHF near you, access only those HF BBSs intended for user access.
2. If you wish to call CQ, call on one of the regular HF packet frequencies, then QSY to a different frequency. This will prevent you from interfering with each other. Before you QSY, decide which station will send a string of long packets to aid the other station in tuning.
3. Don't beacon on the calling frequencies. This will mark you as a lid. A few CQ packets are fine as long as you don't overdo it.
4. Do not operate HF packet unattended. Unattended packet operation is legal only above 50 MHz.

Going a Step or Two Further

Now you're running HF packet. You have a superb FSK transmitter, a super-stable receiver with the perfect 500 Hz filter, and the best demodulator money can buy. Is there anything else you can do to make it better? The answer is yes.

First, you can increase the shift. This will give you more immunity from selective fading, and less intersymbol interference from multipath. However, when you increase the shift, you must also increase the receiver's bandwidth to cover the new shift, plus approximately half the baud rate. For example, for a 400 Hz shift at 300 baud, you need about 550 Hz of bandwidth.

Increasing the bandwidth opens the window for more interference. If you have a demodulator with good filters and a wide dynamic range, and the QSB is not bad, try operating with the AGC turned off. Again, you must accept a trade-off, but the results may be worth it.

You can also try space diversity reception. Unfortunately, space diversity requires two antennas, two receivers, and a demodulator with a circuit that can automatically choose between the two signals. Space diversity is probably the best weapon against multipath distortion. (There is a third technique, frequency diversity, that requires only one receiver, but the sender must send the same signal on two different frequencies. This approach is not unacceptable for amateur radio.)

Real improvement in HF packet radio will come from two sources: better modems and forward error correction. Better modems will probably offer higher baud rates, along with improved resistance to multipath and interference. Forward error correction will allow the receiver to correct most bit errors in the packet so that the transmitter does not have to send the packet again.

Ready for HF?

For easy operation, use direct FSK, get a narrow filter in the receiver, tune carefully, and be polite. If you take extra care in setting up and operating, your HF packet station will pay for itself many times over.

Simple CW IDer

Automatic operation for repeater or fox . . .

by Glenn M. Cascino WN0EHE

For the past few years I've been involved with a 2 meter foxhunting group. Customarily, the winner of the hunt becomes the fox (hidden transmitter) for the next hunt. Being the fox is a lot of fun, but it can also cause some problems. What does one say for two hours straight? What type of transmitter should be used? Usually an HT is not suitable as a hidden transmitter, because of its low power and short battery life. Therefore, most people hide in their cars and use their mobile rigs. This makes for some very interesting hunts. But what if a portable transmitter was available that could run continuously and unattended for portable operation?

In a surplus electronics store, I found an old solid state Genave transmitter that was set up for data telemetry operation on the 150 MHz band. After being the fox a couple of times and running my five-hundred-dollar Yaesu dual-bander almost continuously, I found a use for that old telemetry transmitter. It did not have a microphone preamp since it was originally used for telemetry. Rather than build a preamp for it, I built a CW IDer. This solved the problem of what to say while hiding, and allowed unattended operation in a small portable and very "hideable" package.

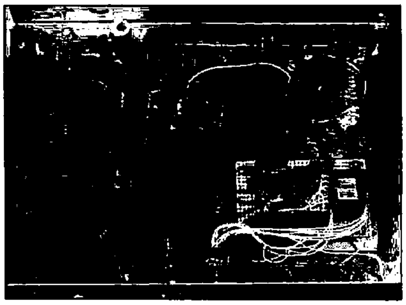


Photo A. Inside of the hidden transmitter. CW Identifier board is in lower right of the photo.

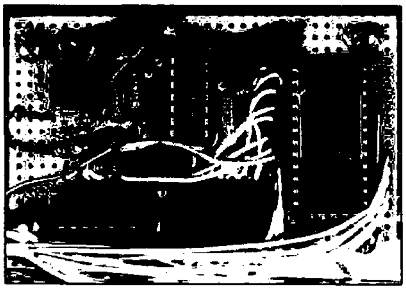


Photo B. CW hidden transmitter identifier.

Photo C. Hidden transmitter in enclosure with heat sink for continuous duty operation.

The CW Identifier

Several members of the foxhunting group might use the portable hidden transmitter, so it should have several call letters available on the CW identifier. I built the identifier with TTL LS logic circuits. I used a dual 555 timer for CW rate and a 1 kHz audio oscillator (see Figure 1). The design is based on a 2716 EPROM (Erasable Programmable Read-Only Memory). One half of the 556 feeds two 7493 ripple counters (or one 74393), giving a binary output counting from 00 Hex to FF Hex, or 256 counts. The eight outputs from the ripple counter are connected to the address lines A0 to A7 on the 2716. A8, A9, and A10 are not used so they are tied to ground. The ripple counter steps the 2716 through the first 256 addresses and continues to loop indefinitely.

In this application, the eight data lines on the 2716 are analogous to an 8-track magnetic tape, where all eight tracks are parallel to each other. Only one "track" or data line is read at a time. This allows you to program eight different CW calls or messages into the PROM. For our foxhunting, we programmed eight callsigns followed by "hidden transmitter." We used a ten-position rotary switch to select one of the eight data lines, one position for continuous tone, and the other position for no tone. The selected data line is connected through the rotary switch to pin 4 of the 556, enabling the 1 kHz audio oscillator. R6 and C5 filter the square wave from the 556 using a first order low-pass with a corner frequency

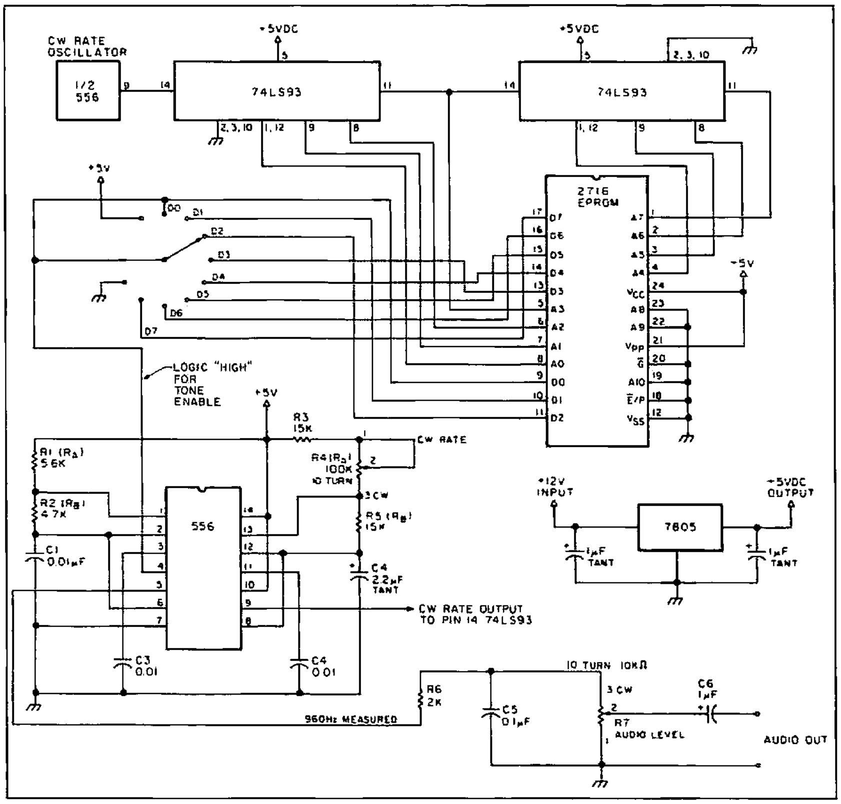


Figure 1. Hidden transmitter CW identifier schematic diagram.

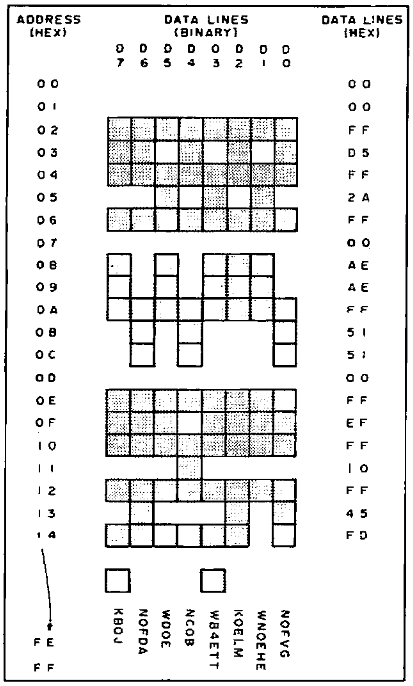


Figure 2. An example of how to derive data words for PROM programming. (Only the first 14 address locations are shown.)

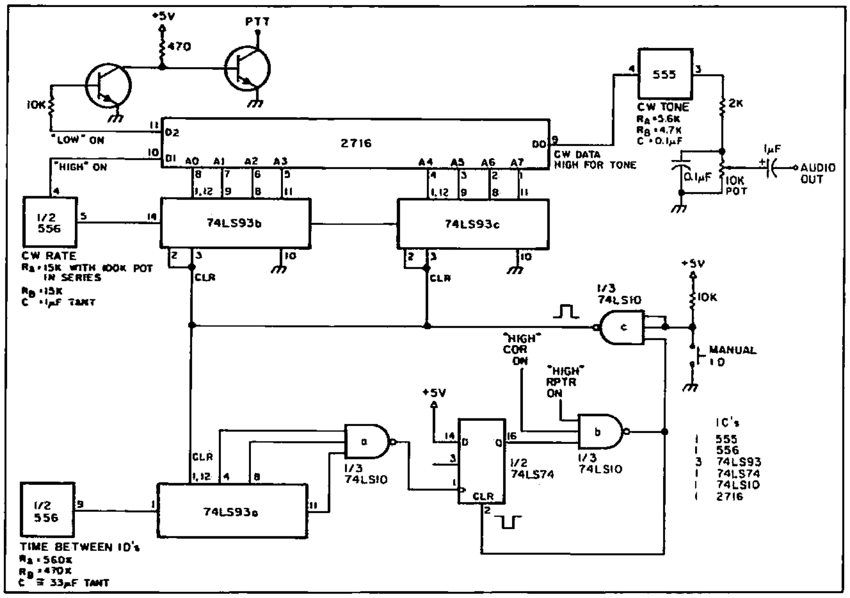


Figure 3. Repeater identifier schematic diagram.

of 800 Hz, providing an audio output closer to a sine wave. R4 allows adjustment of the CW rate and R7 provides a wide range of audio output. The 7805 voltage regulator provides +5 volts to power all circuitry. The completed hidden transmitter with CW IDer is shown in Photo A.

The transmitter has been heat-sinked for continuous duty operation at a rated power of 10 Watts. One knob near the S0-239 connector allows for continuous power selection from 200 mW to 10 Watts (transmitter modification by WB4ETT and N0FVG). The other knob selects one of the eight programmed CW call letters. A terminal strip lets you connect a battery, with external PTT and audio, if desired.

Programming the PROM

You should set up a list (as in Figure 2) to program the PROM. Enter the message for each data line vertically, using one location for a dot and three locations for a dash. After you have entered all messages, you can calculate the hexadecimal value for each address. Then you can program the first 256 addresses of the 2716 using any type of PROM programmer.

A Repeater Identifier

With additional circuitry, you can make a repeater identifier (see Figure 3). You use one data line (D0) for CW data information, again gating the audio oscillator. You can use the other data lines for control functions. D1 enables the CW rate oscillator when an ID is in progress. D2 keys the repeater transmitter. TTL logic inputs are provided for "COR present" and "repeater on."

Circuit Operation

One half of the 556 timer provides clock pulses to the 7493(A) and the 7410(a). In ten minutes the D flip-flop (7474) is clocked, causing Q to go high. If the repeater is on and COR is present, the output of the 7410(b) goes low, resetting Q to a low state and providing a high pulse output from 7410(c). This clears all ripple counters and starts the ID sequence.

When the ID is completed, D1 goes low to prevent further clocking of the 2716. All circuitry remains in this state until another ten minutes passes and the D flip-flop is set again. If Q is set, it remains set until the "repeater on" and "COR present" lines are both high, at which time the ID sequence is again initiated.■

73 Review *by Mike Baker W8CM*

Star Circuits 6 Meter Filter

No more TVI from 6-meter signals.

Star Circuits
PO Box 8067
Pembroke Pines FL 33084
Price Class: $30 (quantity discounts)
Tel. 305-572-2913

Anyone who operates 6 meters usually finds that his first award is WANTS, for "Worked All Nearby Television Sets." Even low-power 6 meter operation can make your neighbors take amazing notice of you. I run kilowatts on 1.8 through 432 MHz, but my neighbors only notice I'm on the air when I'm running 50 Watts on 6 meters!

Hams looking for RFI filters for 6 meters become frustrated. TV high-pass filters generally attenuate the HF bands, but they let 6 meter signals through because it is adjacent to Channel 2. Generally, optimized low-cost filters have not been available for the 6 meter band. A 6 meter filter had to be home-brewed from a piece of coax or twin lead as a stub filter. These stubs were difficult to tune (after cutting off too much, just try putting a quarter-inch back on!), bulky, and only marginally effective. Also, since no one makes a type "F" T-connector for coax, you had to roll your own by modifying a splitter assembly.

A 6 Meter Filter at Last!

A new filter from Star Circuits may go down in 6 meter annals as the best thing to come along since sliced bread. This filter will be welcomed by active 6 meter operators and those who are staying out of the fun for fear of RFI. Star Circuits designed this filter, the 23-H, as a cousin to their existing line of cable TV filters. At my suggestion, Fred Kurtz, owner of Star Circuits, agreed to build a prototype filter for testing. Three cheers for Fred! Though not a ham, he was willing to listen to my entreaties.

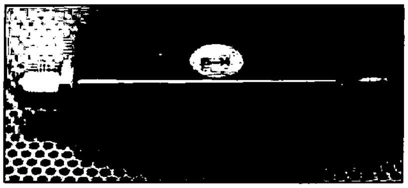


Photo A. Star Circuits' 6 meter filter.

Installing the Filter

Installation of the 23-H turned out to be simple. The filter has standard type "F" fittings and can simply be placed in the antenna coax. You can mount the filter directly at the back of the TV set or VCR with a standard "barrel" male/male adapter (available from Star Circuits for 50¢ or at any Radio Shack for $1.69).

Operation

The filter is a band-reject device that tunes the entire 6 meter band with a notch attenuation of up to 37 dB (see Figure 1).

The 23-H filter comes with easily set adjustments for both the notch frequency center and bandwidth. I set the test filter for maximum notch depth and minimum bandwidth at 50.150 MHz. The filter's passband nicely covered the normal SSB portion of the 6 meter band. Additional attenuation or other notches could be obtained by inserting the filters in series and tuning for desired effect. The insertion loss of one filter was measured at 2.2 dB, so the effect on the TV picture is negligible.

Conclusion

No device alone will ever be a cure-all for 6 meter RFI, and this filter will not solve problems caused by power line pickup or audio rectification. Regardless, Star Circuits' 23-H filter does give the 6 meter operator a valuable weapon against RFI that comes in on the antenna coax line.

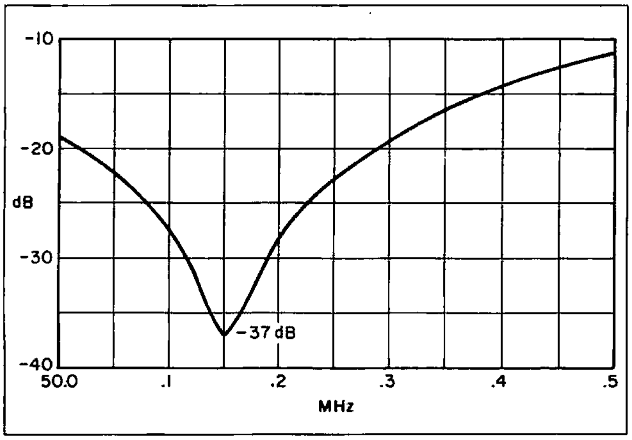


Figure 1. 50–50.5 MHz attenuation curve for Star Circuits' 6 meter filter, part number 23-H.

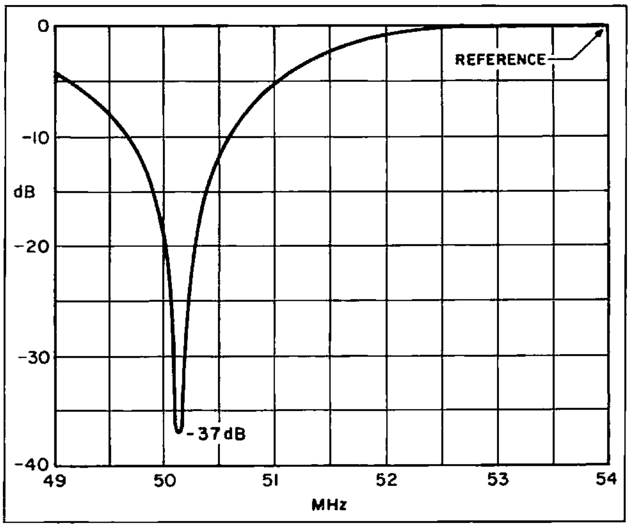


Figure 2. 49–54 MHz attenuation curve for the 6 meter filter, part number 23-H.

Number 19 on your Feedback card

HAMSATS

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
14714 Knightsway Drive
Houston, TX 77083

AMSAT GENERAL MEETING

Space Symposium 1988

AMSAT is moving forward. During the 1987 meeting in Detroit, the organization emphasized two goals: In the near future there will be some sort of PACSAT or digital satellite compatible with packet radio, and the long-term focus will be on Phase 4 geostationary satellite development.

While design and engineering of Phase 4 continues at a measured pace, the packet satellite project has exploded with activity. Although there has been some controversy, the designers and builders are in the last stages of putting the first four Microsats in orbit. Instead of a simple mock-up, a real flight model was on display at the AMSAT General Meeting and Space Symposium in Atlanta last November. Except for the "Do Not Touch" signs, this small package, just nine inches on a side, was right there for all to see. For the '90s, AMSAT continues pursuing Phase 4, but the next two years will be dominated by Microsats.

An Exciting Interruption

Saturday morning, just after AMSAT Executive Vice President John Champa K8OCL had completed the official welcome and introductions, a few hams were seen setting up a type of VHF station in the parking lot in front of the Atlanta Airport Marriott Hotel. Leonid Labutin UA3CR was with them. Leo had been invited to previous AMSAT meetings, but this was the first time he had made it to the U.S. He reported that, just four days earlier, a contact had been made between U2MIR, onboard the Mir Space Station, and UK3KP in Moscow. Now it appeared that these hams were going to attempt a contact from the hotel parking lot to the orbiting Mir.

We were not disappointed. At 1540 UTC, Saturday November 12, Byron Lindsey W4BIW, AMSAT Convention Chairman, had the honor of making the first U.S. to Mir amateur radio contact on an undisclosed 2 meter frequency. Byron's "earth station" used an ICOM IC-2AT with a 30-Watt amplifier and a dipole antenna aimed by *Satellite Experimenter's Handbook* author Martin Davidoff K2UBC. Although signals were very weak on this short pass, later contacts with Vladimir Titov U1MIR, Musa Marinov U2MIR, and the onboard doctor U3MIR were much better.

Any satellite operator can work the Mir space station. Although many contacts have been made on the direct frequency of 145.55 MHz, the official uplinks are 145.525 and 145.575 MHz. The downlink is 145.55 MHz. According to Leo UA3CR, the rig used by the cosmonauts for the early contacts was a Yaesu portable model purchased in the U.S. by UA6HZ. It was allegedly sent into space in a box that was supposed to be carrying a cake. The Mir ham antenna is a simple quarter-wave whip mounted externally. A 10-Watt 2 meter rig built by hams in the Soviet Union and Hungary is to be sent up later. As with American efforts to put ham radio into space, the Soviet proposals for the same have been denied until recently.

Photo A. Several hams look on as preparations are made for the first US to Mir Space Station amateur radio contact.

Amateur Radio Club to make arrangements and coordinate the event. This was the second year for a parallel session of talks. There was not enough time in the weekend for all of the papers to be presented sequentially. The satellite enthusiast faced serious choices due to the many fascinating topics covered concurrently.

Photo B. Leonid Labutin UA3CR discusses Soviet packet radio operation from space over a microsat.

Accurate tracking information for Mir is hard to find. Although NASA provides Keplerian element sets from the Goddard Space Flight Center to those requesting them, by the time hams receive them via mail, they may be seriously outdated. Mir is in a very low orbit. The decay rate is significant and the cosmonauts frequently use thrusters to maintain orbit. Although this may sound like something from Star Trek, it is a very real situation caused by atmospheric drag. Our own Skylab succumbed to drag and re-entered several years ago. Hamsats users can find reasonably correct tracking data for Mir via the AMSAT 20 and 75 meter nets.

W5LFL, WØORE and DPØSL were the first calls heard from space. We have now heard U1MIR, U2MIR, and U3MIR. Several more "MIR" callsigns are expected as more cosmonauts are authorized for ham activity via the Soviet space program. Upcoming projects may also include packet radio from Mir. Space-ready TNCs are already on the workbench in Moscow.

Back to the Symposium

Even without the excitement of such a historic moment as the *Mir*-U.S. ham contact, the Space Symposium would have ranked with the best. The Atlanta AMSAT group worked with the Atlanta

Programs on Saturday began with AMSAT Vice President of Operations Courtney Duncan and his presentation on the future of the amateur satellite program's control station operation. When the first set of microsats are launched, controllers will be needed to maintain satellite operating schedules and monitor vital signs.

Stan Sjol WØKP followed Courtney with an update on progress made at Weber State College in Ogden, Utah, toward the microsat and Phase 4 projects. Weber State was responsible for the NUSAT-1 satellite launched from the shuttle cargo bay a few years ago.

Other early morning papers included one by W4ITJ on satellite orbital characteristics prior to atmospheric re-entry and another by JM1MCF, JR1SWB, and JK1VXJ dealing with multi-microsat data transfer management. Although the microsats are not yet in orbit, discussions and studies are already underway to determine efficient use of the resource of inter-satellite communications.

AMSAT directors Dr. Tom Clark W3IWI and Dr. Bob McGwier N4HY teamed with Lyle Johnson WA7GXD of TAPR (Tucson Amateur Packet Radio Corporation) to present progress on AMSAT's Microsat/Pacsat program, the DSP (Digital Signal Processing) project, and the joint efforts of

AMSAT and TAPR to finalize hardware for amateur use.

Capping the morning was a field organizational meeting hosted by Doug Loughmiller KO5I; the microwave beacon system of Charles Osborne WD4MBK; RS-11 ionospheric experiments by KT7D, KV7B, and Jeff Schoen; and notes on the proposed American space station ham radio activities by Ed Stluka W4QAU.

Saturday afternoon was packed with more exciting talks. ZS6AKV described BACAR (Balloon Carrying Amateur Radio) efforts in South Africa while N4HY, WA7GXD, and NØADI continued with microsat and PACSAT software and hardware descriptions.

AMSAT Vice President of Engineering and Board of Directors Chairman Jan King W3GEY gave an update on AMSAT-OSCAR-13. Dick Jansson WD4FAB presented a mechanical engineering status report on the AMSAT Phase 4 project complete with drawings and descriptions.

Other talks in the afternoon sessions included a Skitrek wrap-up report, the future of the Japanese amateur radio program, and a mission profile of the NOAA-H weather satellite.

No one could possibly attend every talk or absorb all of the material. In recent years AMSAT has recognized this problem and has published copies of the proceedings. 1988 was no exception. A copy can be purchased from AMSAT-NA for $12. Call 301-589-6062 or write to AMSAT, P.O. Box 27, Washington, DC 20044. AMSAT members may also rent copies of the videotapes that were made of all talks at the Space Symposium.

The symposium was followed by a banquet with keynote speaker Geoffrey Perry of the Kettering Group. Known worldwide for their incredible ability to decipher Eastern Bloc satellite telemetry, the group's methods appear as a mix of intuition and black magic. Tenacious perseverance and insight have allowed this group of mostly high-school students to decode encrypted signals from Chinese and Soviet satellites using only simple equipment.

Leo UA3CR followed Geoffrey with updates on Soviet hamsat projects and the possibility of a joint Soviet-American Antarctic Skitrek. Outstanding AMSAT volunteers were recognized, prize drawings were held, and speeches were made by the AMSAT officers.

If Saturday wasn't long enough, those wishing more stayed for the Board of Director's meeting on Sunday and Monday. Changes were made to the AMSAT publications, a new set of bylaws were approved, and Leo became UA3CR/W4. On Sunday morning, he passed his Novice and by dinner he had passed all the requirements necessary for a U.S. Extra-class license.

Times are changing and AMSAT truly is moving with them.

A-O-13 operating schedule up to March 15, 1989:

Mode B	from MA 3 until MA 100
Mode JL	from MA 101 until MA 150
Mode B	from MA 151 until MA 240
OFF	from MA 241 until MA 2

A-O-13 operating schedule from March 16 until May 3, 1989:

Mode B	from MA 100 until MA 150
Mode JL	from MA 151 until MA 210
Mode B	from MA 211 until MA 0
OFF	from MA 0 until MA 100

Table 1. Early 1989 A-O-13 schedules. MA (Mean Anomaly) defines the satellite's orbital position where MA 128 is apogee and MA 0 or 256 is the perigee.

Updates

RS-10/11 continues with Mode A (2 meters up and 10 down) seven days a week. On weekdays, Mode K (15 meters up and 10 down) and Mode A may be activated simultaneously. Mode T (15 meters up and 2 down) will not be activated due to interference problems with the main payload. RS-10 is still operational but will only be activated if something goes wrong with RS-11.

Fuji-OSCAR-12 was available in December for limited periods. The declining batteries and poor power budget have weighed heavily on this satellite. JAS-1B is reported to have 50 percent more power, improved antennas, and sun-sensor. No launch has yet been identified. Check the AMSAT bulletins for current information.

Check The Polarization

Many have compared operation via AMSAT-OSCAR-10 and AMSAT-OSCAR-13. A few even decided that A-O-10 works better than A-O-13. There are reasons for this. First, if a station listens to A-O-13 while the satellite's directional antennas are aimed more than 40 degrees off, signals will be weak. A-O-10 transmits on its omni antenna, so pointing angle is not as critical. Many stations are using linear downlink antennas or circular polarization antennas that are set for left-hand circular rather than right-hand circular (favored by A-O-13). My own KLM-14C was wired for LHCP. To go to RHCP the relay must be energized. Check your system and operate around times when Mode S (70 cm up and 13 cm down) is activated. The ground-control stations command Mode S "ON" whenever pointing angles are best (usually around apogee, the orbit's high point) since satellite off-pointing is most critical then. When A-O-13 favors your location, signals will be fantastic. During the best times, reports of reception using only simple whips are common. ■

Photo C. Ready for launch, an AMSAT NA microsat was on display at the space symposium. It will be launched into a polar orbit via an Ariane rocket.

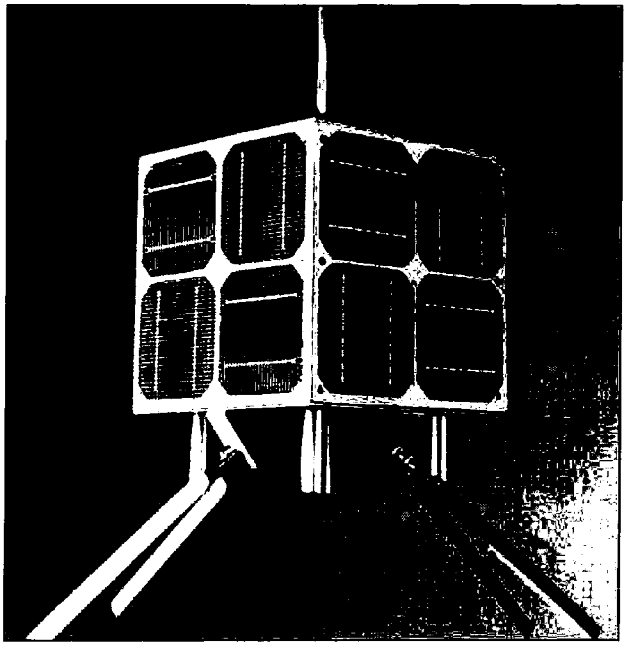


Photo D. Scale model of ITAMSAT from AMSAT Italy. Italy's first satellite may be launched within a year.

Number 20 on your Feedback card

LETTERS

From the Hamshack

The Vote's In On 73s And 88s!

Yes, I vote against Best Regardses and Hugs and Kisses or 73s and 88s.

I know that some use it as a matter of convention. Most hams that go back 20, even 10 years, still believe in clean signals, proper procedures, and the old-fashioned ethics of amateur radio.

I personally don't feel that it is possible to ever return to pride of self, accomplishment, and being a good operator, and a technically-informed operator. We are stuck with what we have become. At least the FCC has enough sense to start reassigning frequency assignments to the commercial people (i.e. 220 MHz).

Joe Feagans
Tallula, IL

Joe, thanks for taking the time and effort to send your comments.

Your opening comments clearly refer to the vote set up in the September issue by the then-Editor-in-Chief Larry Ledlow, Jr. NA5E. Larry called for this vote as a result of a letter sent to us by Brent NWØT ("Letters" September 1988). In that letter, Brent claimed that "73s" and "88s," defined in December 1987 73 "Welcome Newcomers," are incorrect, because the plural meaning was already incorporated in the numbers. Evidently, NA5E, as well as myself, had learned the convention—right or wrong—of putting the "s" on the end of 73 and 88, as he then had final say on all editorial material.

The final tally:

Against the use of the "s" 2
For the use of the "s" 2
"Who really cares?" 5

Thanks to all who participated in this vote!...NS1B

Who Cares?

I wonder sometimes if people like NWØT have anything better to do in life than try and impress others on how gracious their English and knowledge of the Amateur Radio rules are.

I like saying 73s and sometimes I like saying 88s, but to have someone tell me that just because I talk with a little twang, I have to change? Tell Brent to take a hike and impress someone else, as he only goes to show you that being a HAM takes all kinds. Elmer, his teacher, as well as others have to change with the times and accept the new words and new slangs that come about!

The world is changing, Brent, hope you do too! Frank N9GQR

'Nuff said!

Not Another Noah!

I recently coined a new term and definition in ham radio, and thought I would submit it to *73* to share with the rest of the world.

R-I-G-A-M-O-R-T-U-S—"That state in ham radio in which your finals smell like burnt shoe leather, making your key good for only cracking walnuts."

Francis Dohanich WB5PUB
Austin TX

Thanks a lot there, Francis, we think.

Really, Really Rad

Damn, you write provocative and informative editorials.

Thank you for the lengthy and thought-demanding work in the November issue. I respect those who "never say die" and live their lives in harmony to that philosophy. The more of your editorials I read the less radical you seem... or is it the more radical I seem. Whatever, I can see the power of your pen and appreciate it.

It is most difficult to appeal to the good judgment of a bureaucracy such as the ARRL without getting the feeling you have violated the sanctity of ham radio, and proud tradition. Just as it is tradition that chokes the life out of most denominations and their applications in Scripture, likewise it is tradition that is choking the life from ham radio. We have no Pope or final authority above us, so we have turned our own destiny over to the tyranny of tradition. If we ain't done it (sic) that way previously, it must be wrong.

You have helped me get a grip on this destructive and pervasive attitude, and I commit myself to seeking new ways to advance my hobby.

Doug Strange
Comanche OK

Whew!

Number 21 on your Feedback card

ATV

Ham Television

Mike Stone WB0QCD
PO Box H
Lowden Iowa 52255

Advancing the State of the Art

73 Magazine is taking a more technically-oriented tack now, and so shall the ATV column! For the past two years, many of you have followed this column each month to enhance your knowledge of fast and slow scan TV operation. Many of you have also bought or built your own ham TV gear, and now you're on the air, sending live black and white, or even color, amateur TV pictures across town or within the county. Some of you have become really serious about ATV DXing, even out of state. Great going!

Stay with us in 1989, and we'll take you even further into the mystical world of the video waveform. In future columns, we will cover easy-to-build receive downconverters, transmitters, synch signal-stretchers, antennas, preamplifiers, bandpass filters, simple video switchers, and much more. We'll look in depth at computer programs designed for ATV graphic applications, and explain how to mix SSTV, FAX, RTTY, packet radio and other modes with FSTV. We'll compare AM and FM TV signals based on the results of studies, and explore ham TV on the 900, 1200, and 2300 MHz bands.

I've received many letters asking about how to form an ATV club, write a constitution, and build a group ATV repeater or remote transmitter. Keep those cards and letters coming. We'll cover these and other facets of ham TV in coming ATV columns.

AEA Unveils New Fast Scan Rig

Those active in fast scan TV are well aware that Advanced Electronics Applications has added a new UHF ham TV transmitter to their line of amateur specialty equipment. The FSTV-430 ATV rig was unveiled late last year. The introduction of AEA into the ATV marketplace shows one major manufacturer's belief in a yet-to-be exploited visual mode of communications. Other manufacturers are rumored to be close behind. At the Dayton Hamvention last year, several manufacturers were asking hams, "Do you own a camera or a VCR?" Getting major manufacturers involved in the ham TV marketplace, which has yet to peak, would boost all aspects of FSTV activity everywhere. For a comparison of the three most popular 1-watt ATV transceivers on the amateur market today, see Table 1. The results were based on rigs tested locally by the BRATS ATV Club in Iowa.

To decide which ATV transceiver is right for you, study the features that attract you the most. Ask other hams in your local ATV group what they are running. Wyman Research and PC Electronics also offer partial kits.

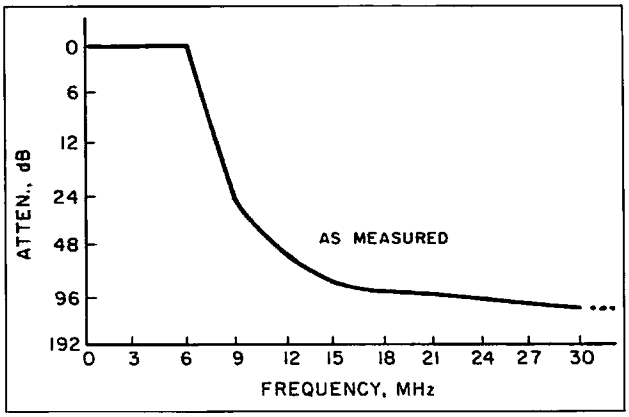


Figure 2. Chart of attenuation vs. frequency for the 7-pole filter.

70 Cm Alert

In most parts of the country, there is still plenty of room for wideband television transmissions on UHF in the 70 cm band. In other parts, hams are moving into the 900 and 1200 MHz region. A QRM-free verbal battle is raging to keep ATV mode operations on the 420–440 MHz, or 70 cm band. Loss of the 70 cm band for ATV operation would be a disaster. An estimated eighty-five percent of hams now on the 70 cm FSTV band in the US, doubt whether they would continue operating ham TV on higher bands. I feel it's worth fighting for. Others may disagree, but the important thing is for motivated hams to build or buy some equipment, and start having some of the FUN that the rest of us are enjoying!

ATV Workbench Projects

Many fast scanners continue to build their own equipment. Merle Reynolds W9DNT in Illinois, Gerald Cromer K4NHN of South Carolina, "Captain Video" Ron Cohen K3ZKO of Pennsylvania, Dave Williams WB0ZJP of Missouri, Mel Dunbrack W1BHD of Massachusetts, Robert Jett W7KPW of Texas, Don Miller W9NTP of Indiana, and many others have built some of the neatest looking gear for ham TV I've ever seen.

The Line Sampler and 7-Pole Filter

Here are a couple of easy-to-build projects for the ATVer, to take your mind off of shoveling snow or worrying about whether your XYL left your car lights on at the grocery store. The Transmission Line Sampler was sent to me by Bill Parker W8DMR, Mr. ATV of The ATCO Ohio ATV Group (see Figure 1). W8DMR writes: "Sampling the RF field flowing in a transmission line is fairly easy. It is just a matter of inserting a short

Continued on page 73

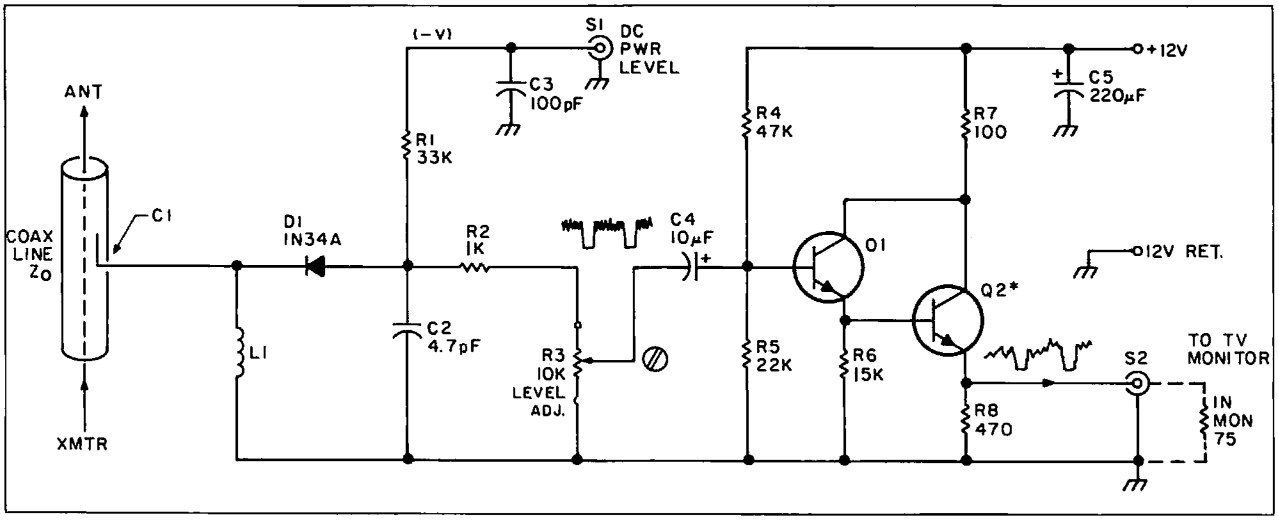


Figure 1. Schematic diagram of the Line Sampler.

Never Say Die

Continued from p. 8

solutions I've suggested are interrelated. For instance, by solving our problem of the gradual death of amateur radio, we also will automatically be providing our country with the engineers, technicians, and scientists it needs to regain its electronic superiority. The Japanese electronics industry is at the heart of their rise to power—the engine driving their whole economy.

We're all well aware that the world is becoming more technical—that technology is the key to the future. But the question is, what can we do about it? We've destroyed the 5000-school radio club infrastructure which brought 80% of our Novices up until Incentive Licensing wiped 'em out in 1964. I proposed a simple way around that problem—via a self-teaching eight-year course for all children in grades 5–12 in the fundamentals of electronics, communications, and computers.

The self/peer-teaching aspect is to get around the lack of teachers. It would take at least ten years and millions of dollars just to build a supply of science teachers. We haven't got those ten years to spare—or the millions.

Since there seemed to be an interest in reducing the national debt, I proposed a way to cut billions in government and military waste. I suggested an inexpensive way to end the war on drugs, thus cutting crime by about 75% and contributing toward a solution to our education problems. I proposed an inexpensive solution to welfare and the homeless. Just think of the money we'd save if we weren't fighting an ever escalating war on drugs, supporting millions of welfare families, and living with incredible waste in government!

I believe the American educational system can be made productive and brought back to #1 in the world—and without throwing billions of dollars at the problem to do it. All of my solutions are designed to be primarily self-funding, depending more on entrepreneurs than the government. And I do have a Ph.D. in Entrepreneurial Science, if you need that reassurance.

Now, I can't do all of this alone. I need your help. I don't think there are any amateurs who really want amateur radio to be lost—yet that's the way things are going right now. If you can help me get my fundamental electronics course started in grade schools, we'll not only get amateur radio growing again, but we'll also be developing the engineers we're going to need in the next century. The kids who are in the 5th grade now will be the college graduates of 2000, so we'd better get 'em interested in technology right now. Or else.

How can you help? I'll be writing about that. I need your help in many ways. I need it at the federal level to help get the government behind a move to bring electronics courses into our grade schools. The decisions on this, though influenced by the federal government, are made by the states, so I'm going to need help with state governments.

> ***"The Japanese electronics industry is at the heart of their rise to power. . ."***

You can also help with your own children and grandchildren—and I'll be writing about that. You can help in your community by working with your local schools to start radio clubs so we can rebuild our lost infrastructure.

You can work with your local radio club to make amateur radio more fun for everyone. We need to rebuild a spirit of cooperation and excitement. We need to counter the infighting and anger—the frustrations. We need to get away from repeater and net jamming—from those stupid ham lawsuits which are wasting money and time and generating fear. I'm not asking for anything we can't do or that we won't enjoy doing.

I need your help in getting more readers for *73* so we can make a difference. If every reader could get one more ham to subscribe to *73*, we'd have the strength we need to not only rebuild amateur radio, but also to make a significant difference in America.

Yes, I agree, unless you know how to go about it, one person usually can't make any difference. But when you know where the lines of power run, you can tap in on them and even one person can make a profound difference. I discovered this for the first time back in 1970 when I found that I was able, with the power of *73 Magazine*, to make repeaters and FM happen. And I did make that happen.

It was my success with repeaters that gave me the courage to tackle the microcomputer when it first appeared in 1975. It was that confidence which drove me to start *Byte* magazine—then *Kilobaud*, *Microcomputing*, *80-Micro*, *Desktop Computing*, *RUN*, *InCider*, *Hot CoCo*, *Micro Industry*, and others—plus publish dozens of computer books, to build Instant Software with over 250 programs for fun, business, and education. I soon became the largest publisher in the field.

It was this same confidence that I could make a difference that got me to start *Digital Audio* magazine to support what was then a brand-new audio technology. With the help of my publications, compact discs have become the fastest growing consumer electronics industry in history.

One person really can make a difference. *You* can make a difference. You can do this by learning how to tap into the power system which runs America. Part of it is the media, part is Congress, and part is your local and state governments. These power systems are far easier to influence than most people suspect. Well, I know how to use these systems and I'm going to teach you how to do it. We're going to use this knowledge to get amateur radio going, and that's going to get America growing. Let me ask you, do you see any other route to getting America back to #1? Any?

To make this happen I need double the number of *73* subscribers. Even knowing how to use the power system, I still need your help. Once I show you how to use it you'll be astounded at how effective you, one person, can be in making things happen. We have the lever to move the whole world—starting with America. But I need 100,000 people leaning on that lever with me, so let's get started getting more *73* subscribers. 73

Number 22 on your Feedback card

ABOVE AND BEYOND

VHF and UHF Operation

Pete Putman KT2B
3353 Fieldstone Drive
Doylestown PA 18901

We Get Letters...

Time to hit the mailbag, which I've neglected over the past few months. Some noteworthy correspondence has come in from a variety of sources, and all of it merits discussion. So without further ado...

Microwave Propagation

Glenn Elmore N6GN had some interesting comments regarding the "Trip Through the Microwave Spectrum" article in the October *73*. Glen feels that some of the points about propagation might deter more activity on the microwave bands and that clarification is in order.

Glen took exception with the statement that "Radio waves at this frequency propagate line-of-sight and are largely limited by atmospheric attenuation." Granted, this is a very broad statement, and path losses at these frequencies are higher than in the VHF and UHF bands. He described a table from the *ITT Reference Data for Radio Engineers* that plots attenuation in decibels per kilometer (dB/km) versus precipitation in millimeters/hour (mm/h) as a function of frequency.

Using this table, Glen claims that "atmospheric attenuation is really not a very significant issue, even in situations of heavy rainfall, until the 24 GHz amateur band." The table shows that with precipitation of 10 mm/h (about 0.39 inches/hour), the additional losses over a given line-of-sight (LOS) path at 2.3 GHz amount to an extra 0.0014 dB/km, which is fairly insignificant. The RSGB *VHF/UHF Manual* corroborates this table, attributing about a 1.5 dB increase in attenuation over a 10 GHz LOS path with 50mm/h rainfall, which is a fairly heavy shower, and certainly not the norm.

Glen goes on to calculate that a station running 1–2 Watts with a 20 dB antenna can achieve successful communications over a greater path than the 10–15 mile radius described in the article. He sets up the assumption that both stations at the ends of a hundred-mile LOS path are using 20 dB antennas. The total signal strength ratio = [+30 dBm (TX power)] + [+20 dBm (TX antenna)] + [−145 dBm (path loss)] + [+20 dB (RX antenna)] = −75 dBm signal. Assuming an SSB signal with a 3 kHz bandwidth, the noise floor ratio is [−139 dBm (KTB in 3 kHz)] + [+3 dB (RX noise figure)] + [+3 dB (terrestrial noise)] = −133 dBm. Subtracting −75 dBm from −133 dBm leaves 58 dB S/N. (His assumed feedline losses have been factored into the antenna gain and noise figure calculations.)

Reality Check

These figures, however, are for a true line-of-sight path, not one partially obscured by trees, buildings, etc. The reality is that many home microwave stations are not functioning over LOS paths during a large percentage of their contacts, and have to contend with numerous obstructions, as well as multipath and other distortion of the propagated wave. Indeed, here on the East Coast many of the paths regularly worked depend more on troposcatter or ducting effects, which occur so frequently (such as along the coast) that users may assume they have a largely LOS path.

> **"...many home microwave stations are not functioning over LOS (line-of-sight) paths for most of their contacts."**

For the average home station in the northeastern US, there are very few true LOS microwave paths. This typical station has so many factors working against it (feedline losses, foliage, antenna height, noise) that a day-to-day working range is realistically about one-half to one-third the ideal 2304 MHz LOS path (given the above calculations). During the spring sprints in May when there is little or no enhancement, stations running 25–50 Watts to 20 dB+ arrays have to scratch to make contacts over a hundred miles.

As to the effects of precipitation, I have observed significant attenuation when operating from what could be called optimum sites, e.g., mountaintop locations with something approaching true LOS paths to stations over a hundred and fifty miles away. For instance, during my last microwave grid expedition to Cathead Mountain in FN23, I observed erratic paths on 2304 and 1296 back to stations in eastern Pennsylvania and Rochester, New York. At the time, a heavy rainfall had just ended and dense clouds were drifting across the mountaintop during QSOs. Signals appeared to be stronger when the clouds cleared the mountain.

Again, because these were not true LOS paths, it's likely that what I was really seeing was some degree of erratic tropospheric enhancement, caused by cooler layers of air trapped by warm moist air, and a partial duct alternately forming and breaking up to the top of Cathead. This could be misinterpreted as the effect of precipitation scatter or absorption!

Glen's comments are thoughtful and insightful. He concludes by saying, "All of those whom I know that have become active with good narrowband stations at 1200 MHz and above remark how much 'better' these bands are for DX than VHF...I think the prevalent perception of mystery, line-of-sight only and high attenuation...have caused us to miss out on better utilization of these bands." Well put! The true microwave experimenter should take these observations as an incentive to further explore the bands above 900 MHz. You could be pleasantly surprised!

Running 9913 Coaxial Cable

Bertram Green W2LPC writes in to inquire about an old friend...9913 coaxial cable. He plans to run a hundred feet of it through some PVC tubing under his lawn to his antennas. Problem is, the PVC has a tendency to collect water, and he's concerned about the old 9913 bugaboo—water absorption. (We all know that 9913 makes a great garden hose if not properly sealed.)

The first thing to remember about Belden 9913 is that it has a contaminating jacket. That means that water can seep through the jacket and infiltrate the cable, drastically changing its impedance and possibly causing flashover at a high RF voltage point. Therefore, I don't advise direct burial of 9913 is unless it is somehow waterproofed. Running the cable inside a piece of PVC might do the trick, except that condensation can form and collect inside the tubing. If enough gets in there, you might as well have buried your 9913 in the pool!

The logical answer is to simply not use 9913. Select, instead, an appropriate non-contaminating RG/8 cable, such as RG-213. It has higher losses than 9913, but it resists water. Certain types of hard-line are also suitable for direct burial, and this may in fact be the best choice, since the cable needs to be strong and won't be flexed. Prodelin Spir-O-Line and Andrew Heliax are excellent choices. The higher cost of the cable is offset by knowing you won't need to dig up the lawn in six months to replace it!

Bad News and Good News

Thor Stefansson TF6PS wrote from Iceland regarding the use of a Microwave Modules 144/28 transverter to be used with an ICOM IC-751. He reports that the transverter output from the IC-751 is low (no surprise) and he would like to know how to squeeze some extra drive from it. This low output condition also existed on the IC-730, 740, and 745 series radios, where anything from 1 mW to 3 mW was nominally available at 28 MHz. In some cases, the output was even lower and sometimes measured below 1 mW or 0 dBm.

The good news is that late model MMTs have excellent sensitivity in the low-level TX mixer stages. I performed measurements with 1987 model MMT 144/28 10 Watt units and was able to saturate the mixer with as little as 1 mW of drive, so you shouldn't have a problem unless your IC-751 has less output. ICOM typically samples the transverter line well before the last RF driver stage, and I modified my IC-740 to sample the 28 MHz energy just before the PA board. In this case it was an easy modification, as the coax was bro-

ken and brought to the rear panel XTVR jack, and the PA return was through the SPARE jack.

This modification resulted in as much as +12 dBm drive—more than adequate for the job. The modification for the IC-745 was similar, and involved disconnecting the LOW BAND ANT jack to use as the return back to the PA board. Again, the modification resulted in about +10 dBm output as opposed to the +3 dBm output (2 mW) on the stock IC-745. Modifying the IC-745 is somewhat more difficult, as the coax lines to the PA and mixer must be traced back carefully. Otherwise, you may accidentally connect the output from the low-pass filter board and pump 100 Watts, or +50 dBm, into your transverter!

In any case, make sure that the 1.5k, ¼-Watt resistor in series with the input is shorted before you try anything else. Strapping this resistor in both the 28 and 28R models results in about a 7–10 dB increase in output. Increase the sensitivity of the mixer injection level pot slowly and see if the output isn't a lot higher. If that doesn't work, then you may wish to modify your ICOM to obtain the extra drive.

Goodbye, Yellow Brick Road...

Nearly four years ago, I approached the then-Managing Editor of *73 Magazine* with the idea of running a regular column of interest to VHF operators, pointing out the continued growth of activity in FM, packet, SSB, EME, and satellite modes. After much persuasion, "Above and Beyond" became reality in August of 1985, bringing me the challenge of writing stimulating articles on a variety of VHF topics.

The years since have indeed seen a surge of interest above 50 MHz. The 23 centimeter band continues to expand. Fast Scan ATV has helped the growth on 23 and our newest allocation on 33 cm. Grid squares came into widespread acceptance to further stoke the fires, as did the ARRL Sprints and the CQ VHF WPX contest. Equipment for 220 MHz became more readily available, and Novices regained VHF voice privileges after 20-odd years.

There's been a down side, too. The explosion of repeaters and the FCC's decision to back away from regulating ham radio created serious problems. The apparent loss of 2 MHz from 220 comes at the worst possible time on a band that is growing in fits and starts. Both 23 cm and 13 cm felt the butcher's knife as over 50 MHz was removed from the amateur allocations. The 70 cm band remains a likely target.

"I don't advise direct burial of 9913 unless it is somehow waterproofed."

All of these events have combined to focus attention on the VHF, UHF, and SHF spectrum as never before, as both commercial and amateur interests become aware of the potential for these frequencies. If this column has helped to focus that attention in some way, all the better. If someone was persuaded to try a grid hop... buy a new transverter... build a preamp... write a Congressman about the threat to 220 MHz... write to dispute the statements in this column... operate a VHF contest... fire up a packet station... try 6 meter FM... it was worth it.

Sometimes in life you find it necessary to step back and reevaluate many of the activities you participate in. It's a good and necessary process, and more of us should take time to "stop and smell the roses" once in a while. I have decided to scale back my amateur operations for the time being, including writing. It has truly been an enjoyable 3½ years and I have made many friends over that period. It's been a pleasure writing "Above and Beyond," and perhaps one day I will pick up where I left off.

So... keep at it! The majority of bands above 50 MHz are still vastly underused. The key to keeping them in the amateur allocation table is activity... activity... ACTIVITY. And who knows? I might just pop up from a mountaintop in some rare grid to work you... Above and Beyond! 73

ATV *Continued from page 64*

section of transmission line between the transmitter and antenna. The main idea is to make certain that the sampling section does not disturb the impedance of the transmission line. The ideal situation is to keep the transmission line impedance electrically constant. To keep the impedance discontinuities minimal, the physical ratio of the outer and inner conductor sizes must provide the proper impedance and be equal to that of the transmission line sampled." W8DMR gives the formula for calculating the impedance based upon the conductor sizes using air dielectric:

The impedance in Ohms is:

$$Z_0 = 138 \times 10\log \frac{\text{outer inner diameter}}{\text{inner outer diameter}}$$

Ratios of 2.304 and 3.496 provide 50 and 75 ohms, respectively.

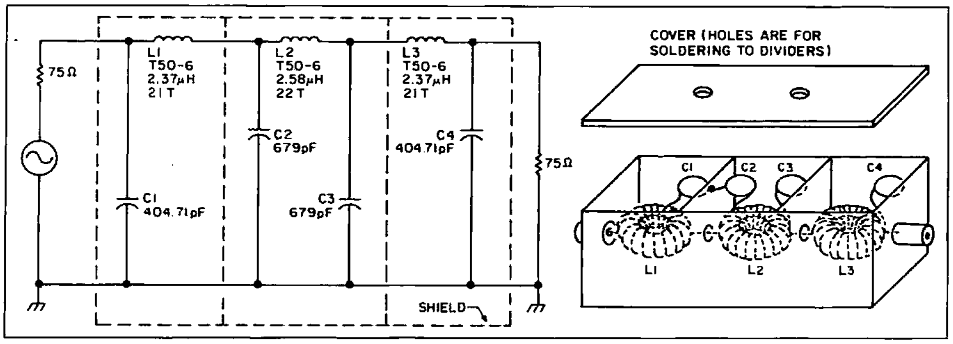


Figure 3. Layout of the 7-Pole Video Filter.

WB6BAP's 7-Pole Video Filter

Here are the construction details on a simple but effective 7-pole video filter designed several years ago by Ernie Williams WB6BAP of the now defunct Southern California ATV Club. This filter helps reduce output garbage at your modulator and may prevent stray RF from creeping into your monitor, VCR, or distribution amplifier (see Figure 2).

It's cheap, simple, and straightforward (see Figure 3). It uses no power supply or active components, and it doesn't heat up. As Ernie said in the later "A5" article, "It is user friendly!"

The inductors are Micrometals T50-6 toroid cores (or equivalent). You may parallel small values or check standard values caps on a bridge to find the closest value. Make plenty of good grounding areas. The enclosure can be anything metallic. Connectors are not important, although Ernie used BNCs. Ground the enclosure to something nearby when installed.

Good luck! Write and tell me how you came out. For more serious filter problem-solving, contact John Beanland G3BVU/W1 at Spectrum International in Concord, Massachusetts. He has some real neat 3- and 5-pole brass and copper specialty filters that are reasonably priced, and which will notch out just about anything! 73's gang and see you next month. . . de WB0QCD.

Parts List for Line Sampler

R1	33kΩ ½ W	input resistor	RS 271-040
R2	1kΩ ½ W	feedback resistor	RS 271-023
R3	10kΩ ¼ W	level adj. pot	RS 271-335
R4	47kΩ ½ W	bias resistor	RS 271-042
R5	22kΩ ½ W	bias resistor	RS 271-038
R6	15kΩ ½ W	base resistor	RS 272-036
R7	100Ω ½ W	collector resistor	RS 276-012
R8	470Ω ½ W	emitter resistor	RS 276-019
C1	1 pF	Ins. wire near coax center lead	fabricate
C2	4.7 pF, ceramic cap.	RF bypass	RS 272-120
C3	100 pF, ceramic cap.	RF bypass	RS 272-123
C4	10 μF, 16 V cap.	coupling	RS 272-1436
C5	220 μF, 16 V cap.	decoupling	RS 272-956
L1	1.0 μH, AWG #26	10 turns, ¼" dia.	
D1	1N34A diode, ger.	demodulator	RS 276-1123
Q1	2N2222 NPN, bipolar	emitter follower	RS 276-2009
Q2	2N2222 NPN, bipolar	line driver	RS 276-2009
HS	heat sink for Q2	cooling	fabricate
S1	connector, BNC	RF level, DC	RS 278-105
S2	connector, SO-239	video output	RS 278-201
PC	pre-drilled PC board	parts mounting	RS 276-150
SK	transistor sockets	optional, 2 required	RS 276-548

A Comparison of Popular 1-Watt Rigs
as tested by the BRATS ATV Club

MFG. Features	PC TC-70	Wyman WR-450
Suggested Retail Price	$299	$300
Transmitter RF Output	1 watt PEP	2.5 watts PEP
Crystal freq. capability	2	1
Vestigial SSB filtered	NO	NO
Cabinet construction	Plastic	Metal
Power supply requirements	internal	included
Camera input connector	10-pin	10-pin
Accepts B/W and Color NTSC	Yes	Yes
Synch stretcher circuitry	Yes	Yes
Synch level WS lockup threshold	Fair	Very Good
Optional video input(s)	Yes	Yes
AM signal stability	Good	Good
Harmonic/Spurious radiation	Fair	Good
PTL (push to look)	Yes	Yes
Transmit Signal Video Monitor	Yes	Yes
4.5 FM subcarrier sound	Yes	Yes
On-carrier audio capability	No	Yes
TV subcarrier squelch	Option	Yes
Internal OC Rcv provision	No	Yes
Front panel controls	Yes	Yes
Transmit/Receive LEDs	Yes	Yes
Receiver sensitivity	Good	Good
Unwanted signals rejected	Fair	Fair
Full-band tuning	Yes	Yes
Service/parts replacement	Yes	Yes

Number 23 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

RALEIGH NC
FEB 11–12

The Raleigh Amateur Radio Society club members will celebrate the 20th anniversary of the founding of their club with a special event station, operating on the weekend of the 11th and 12th, in the general portion of all bands. Members will use their own callsigns. QSL will be by sending a #10 SASE to *RARS, PO Box 17124, Raleigh NC 27619.*

LOVELAND CO
FEB 11–12, 14

KAO Valentines For Friends will be operating in conjunction with the Loveland Valentines Activities from 1500 to 0500 UTC on the above weekend, with some activity on February 14 from 2300 to 0500 UTC.

Loveland has remailed valentines from the world for more than 50 years. Send an SASE for your 8½" x 11" certificate to *KAØVFF, Michael H. Walker, 3816 Ash Avenue, Loveland CO 80538.*

MANSFIELD OH
FEB 12

The Mansfield Mid*Winter Hamfest/Computer Show will be held at the Richland County Fairgrounds in Mansfield. Plenty of prizes, 300-table flea market in large, modern, heated building. Open at 7 AM, tickets $3 in advance and $4 at the door. Tables $6 in advance and $8 at the door. Half tables available. Talk-in, call W8WE on 146.34/.94. Advanced ticket/table orders must be received by Feb. 2. Contact *Dean Wrasse KB8MG, 1094 Beal Road, Mansfield OH 44905. 419-589-2415 after 4 PM EST.*

MARLBORO MA
FEB 18

The Algonquin ARC is sponsoring the Hamfest/Flea Market in Marlboro from 10 AM to 2 PM on the above date. Open for sellers at 8 AM. Place: Marlboro Middle School Cafeteria, Union St., off Rte. 85. Feature: Electronics Flea Market. Talk-in: 146.01/.61 and 146.52. Admission is $2. Tables are $8/each in advance, $10 at door. Wheelchair accessible. Contact *Dan KB1WW at 617-481-1587 or write A.A.R.C., Box 258, Marlboro MA 01752.*

SALEM OR
FEB 18

The Salem and Oregon Coast Emergency Repeater Associations will sponsor the 1989 HAM FAIR on Saturday, beginning at 9 AM at the Polk County Fairgrounds. Admission is $5 in advance or $6 at the door. Activities include giant flea market, exhibits, and commercial dealers. Talk-in on 146.26/.86. For more information, write *Salem Repeater Assoc., PO Box 784, Salem OR 97308.*

DENVER CO
FEB 19

The Aurora Repeater Association will hold its 8th Annual Swapfest on Sunday from 8 AM to 3 PM at the Jefferson County Fairgrounds at 15200 W. 6th Ave., Golden CO. For additional information, contact *Judi WDØHNP at 303-460-1413 or Jan KA7TYU, PO Box 39666, Denver CO 80239.*

FELICITY CA
FEB 25

From 1500 to 0100 UTC, Amateur Radio Emergency Service Hams of Yuma, Arizona, will call all nations from The Official Center of the World in Felicity, using callsign WA6PEZ. 10 meter Novice SSB: 28.418 MHz; 15 meter General SSB: 21.318 MHz; 40 meter General SSB: 7.238 MHz. Call-in on 146.74 Black Mtn. Rptr. For glossy certificate, send QSL, 9x12 SASE and $1 to YUMA ARES ℅US Post Office, Felicity CA 92283. Any profits have been pledged to United Way of Yuma and El Centro. Contact *KCØKV Barry Norrgran, ARRL District Emergency Co-ordinator, 2404 Marion Ave., Yuma AZ 85365. 602-344-2575, evenings.*

CINCINNATI OH
FEB 25–26

The Ohio ARRL Convention 1989 will be at the Cincinnati Gardens Exhibition Center at 2250 Seymour Avenue. Fee is $5 per person, $6 at door. Door prizes, free parking, early morning coffee and doughnuts. Motel rooms available 1.5 miles from convention.

For details on flea market, contact *Lynn Ernst WD8JAW, 4553 Patron Ct., Cincinnati OH 45238. 513-921-4882.* For information for commercial vendors, contact *Joe Weinle WD8JGB, 6060 Dryden, Cincinnati OH 45213. 513-731-3208.*

LA PORTE IN
FEB 26

The LaPorte ARC is sponsoring its Hamfest at the LaPorte Civic Auditorium. Admission is $3.50. Tables are $3/each, reserved in advance. Talk-in is on 146.520 or 146.610 with PL of 131.8. Contact, with SASE *LPARC, PO Box 30, LaPorte IN 46350.*

DEARBORN MI
FEB 26

The Livonia Amateur Radio Club will hold its 19th annual LARC Swap 'n Shop on Sunday from 8 AM to 4 PM at the Dearborn Civic Center in Dearborn. ARRL/VEC amateur radio examinations will be given by the Motor City Radio Club. Plenty of tables, door prizes, refreshments, and free parking. Talk-in on 144.75/5.35/.52. Reserved table space of 8-foot minimum available. For further information, send 4x9 SASE to *Neil Coffin WA8GWL, ℅the Livonia Amateur Radio Club, PO Box 2111, Livonia MI 48151.*

CUYAHOGA FALLS OH
FEB 26

The Cuyahoga Falls ARC 35th annual hamfest will be at the Akron North High School from 8 AM to 3 PM. Tickets are $3 in advance, $4 at the door. Tables are $5, with half-tables available. Sellers may bring own tables. Tables are $6 at the door, if any are left. SASE for ticket orders and table reservations, please. Talk-in on 87/27. Details from *Bill Sovinsky K8JSL, 2305 24th St., Cuyahoga Falls OH 44223. 216-923-3830.*

DAVENPORT IA
FEB 26

The 18th annual Davenport Radio Amateur Club Hamfest is scheduled for Sunday at the Iowa Masonic Temple in Davenport, Iowa. Talk-in on 146.28/.88. Doors to the WØBXR hamfest will open at 8 AM. The event features a large indoor flea market, food, forums, prizes, and ARRL/VEC exams (walk-ins accepted). Tickets are $2 in advance, $3 at the door. Tables are $7 each with an additional $2 charge if an AC hookup is required. For hamfest information, write to *Dave Johannesen WBØFBP, 2131 Murtle St., Davenport IA 52804.* For testing information or preregistration, write to *Al Broendel N9OK, 2712 38th St., Rock Island IL 61201.*

Number 24 on your Feedback card

CIRCUITS

Great Ideas From Our Readers

Have a quick'n'easy circuit idea? Share it and get a one year subscription or extension to *73*! Clearly mark all entries as submissions for Circuits to distinguish them from manuscripts. Send your entries to Circuits, *73 Magazine*, Peterborough, NH 03458.

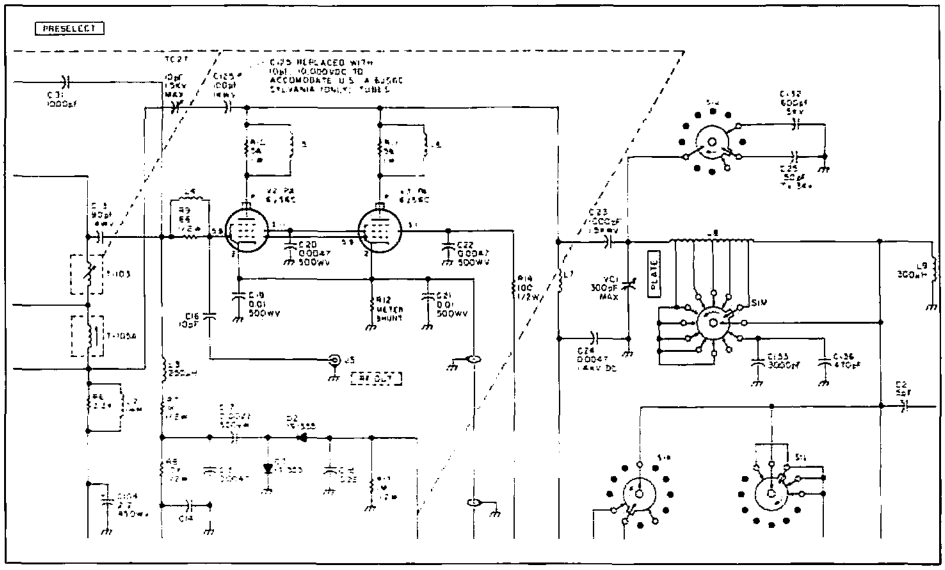


Figure 1.

FINALS REPLACEMENT

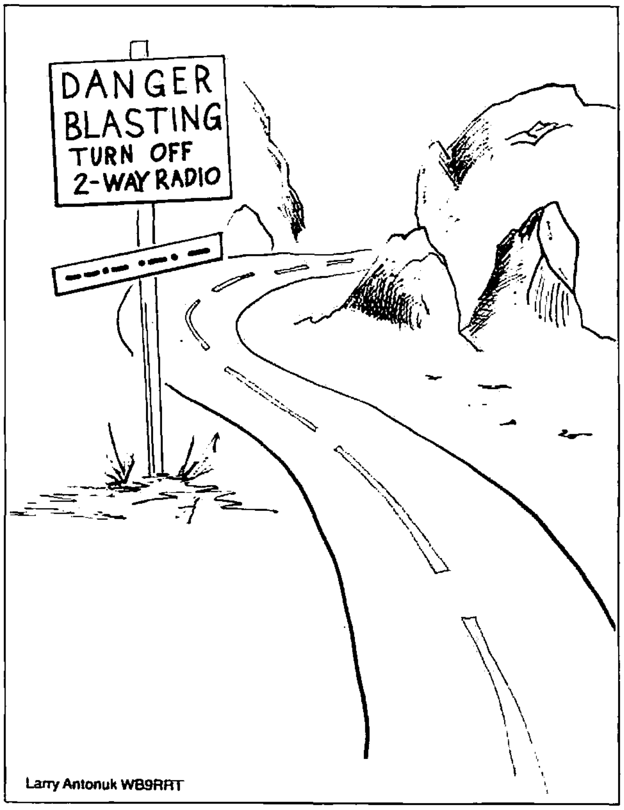
There came a time when I needed to replace a pair of 6JS6C vacuum tubes in the final amplifier section of a FT-101E. A salesperson informed me, however, that I needed to make a major modification in order for American tubes to perform properly and last a long time. The radio was originally equipped with Japanese NEC tubes, which have quite different properties. Not anxious to pay for additional services of unknown complexity, I made several contacts with fellow amateurs.

The modification was much easier than I expected. See Figure 1. It consists of replacing the fixed value 100 pF 1000 VDC mica capacitor with a 10 pF, 1000 VDC mica capacitor. This capacitor, C125, is in series with the 10 pF, variable neutralizing capacitor off of the plate circuit.

If you need to make this modification, be sure to use a mica or silver mica of at least 1000 VDC. Do not substitute a different type, because the heat in the final compartment will change the value, and your tubes will fail prematurely. Also, be very careful to keep all leads short and in exactly the same orientation as the original capacitor.

Before reneutralizing, open the variable neutralizing cap all the way to minimum engagement, and follow the neutralizing instructions in the manual. While dipping the plate, remember to adjust the neutralizing capacitor for equal value meter reading peaks (IC position) on both sides of the dip when tuning the "Plate" control. See Figure 1.

Hank Hausmann WB8RNI
Strongsville OH



TEST FOR DIRTY BIRD

For many beginning hams, the cost of a commercial wattmeter is excessive. If you're using low power, you can make a quick and inexpensive substitute with almost any available milliammeter and a few inexpensive parts, as seen in the diagram. If you're only interested in maximizing output you don't even need to calibrate it, but if you can borrow someone's Bird or equivalent, you can calibrate yours for the frequency you wish to measure. See Figure 2.

Wm. Bruce Cameron
Temple Terrace FL

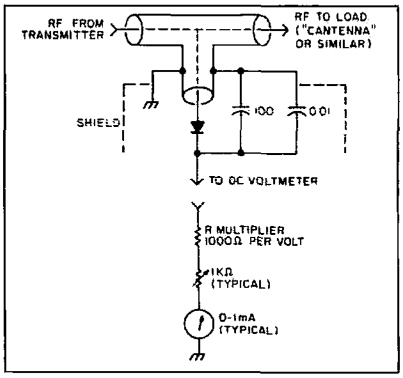


Figure 2.

PORTABLE PACKET

Use your TNC with an ICOM HT! See Figure 3. Radio Shack part numbers are: for C1, RS 272-1432; for R1, RS 271-1341.

Dick Peters
WA1PWF
Norfolk MA

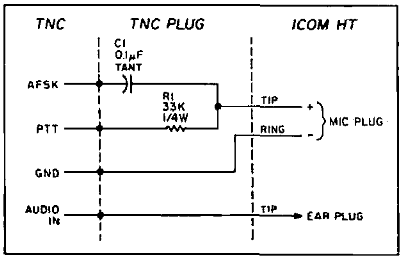


Figure 3.

Number 32 on your Feedback card

ASK KABOOM

The Tech Answer Man

Michael Jay Geier KB1UM
7 Simpson Court
S. Burlington VT 05403

The Way It Goes

About ten years ago, when I was a professional service technician, my boss spoke the words I will never forget: "If it works, it breaks!" Ain't it the truth! Nothing keeps working forever. In troubleshooting, however, I found that parts didn't "go" randomly—some types of parts, in some types of circuits, seemed to nearly always be the culprits, while others could be counted on to be OK. And I've come to believe that understanding this phenomenon is a great part of what separates the expert techs from the diddlers. (An in-depth understanding of the circuit doesn't hurt, either!)

So, this month I'm going to break down common parts by type, in decreasing order of likelihood of failure:

Connections: A connection aisn't always a component, but it can be, in the case of switches and relays. Bad connections are by far the most common cause of equipment failure. Solder joints are included here.

Stressed transistors: These include voltage regulators in power supplies (especially), RF and audio output transistors, and in general any transistors that get warm enough to require heat sinks.

Zener diodes: By virtue of their very function (voltage regulation), they handle significant current and sometimes get hot. Over time, they can go, becoming open circuits. This may result in a power supply going way over its intended voltage, causing all kinds of damage, especially to 5 volt digital ICs in other parts of the rig.

Linear ICs (such as op amps and audio amps): These are frequently required to handle wide voltage swings and surprising currents. They can get hot and die just like stressed transistors.

Small-signal transistors: They will go if over-stressed with too much current, but they can also die for no apparent reason. If you're doing a stage-by-stage signal trace in an IF strip not made from ICs, for example, the transistor in the dead stage will nearly always be the culprit. Be especially wary of FETs and MOSFETs in receiver front ends, as they are easily killed by atmospheric static pulses or nearby transmitters.

Rectifiers: These are pretty reliable, but they can be overstressed like any other semiconductor. They are easy to check with an ohmmeter.

Crystals: They're easy to overlook, but I have seen plenty of flaky and just plain dead ones. They are especially suspect in oscillators that work sometimes but not always.

Digital ICs (such as gates and microprocessors): TTL (74-series) chips die quickly if the supply voltage goes much above 5 volts. CMOS chips are more tolerant and reliable. When digital chips go, the result is nearly always an output line stuck either high or low.

Electrolytic capacitors: These are weird parts. They get leaky, open, and sometimes just plain strange, even occasionally exhibiting diode-like behavior. When in doubt, swap in a new part, even if it is not exactly the same value, just to find out.

Small-signal diodes: These are more likely to be open than shorted. They are easy to test with an ohmmeter.

Resistors: In tube circuits, heat may make resistors drift, but that doesn't happen in low-level solid state devices, and very rarely even in output stages. If a resistor is bad, it will be obviously burned or cracked, and the semiconductor device associated with it will invariably be shorted. If the resistor looks OK, it almost certainly is.

Ceramic capacitors: I've only seen one or two bad ones in my life. It just doesn't happen.

Inductors: Excluding high-voltage transformers associated with CRTs, they rarely go. If an inductor is open, look for a short circuit pulling too much current through it. If it is shorted, age or humidity is the likely cause.

Alignment: No! Sudden changes in performance are caused by bad parts. Don't diddle with adjustments unless and until you are CERTAIN nothing else is wrong!

In general, when checking any stage, first check the output of the transistor or IC, then check its input. If they are both doing something and not the SAME thing, then look elsewhere. (Of course, for digital gates and such, it is a bit more complex than that, but a digital gate with power applied, changing inputs, and no output is probably bad.)

Whew! Now let's look at this month's letters:

Dear Kaboom,

My Yaesu FT-901 works fine most of the time, but it sometimes arcs inside the output tubes upon keydown, especially on 160 meters. Surely that can't be good for the tubes. What gives?

Signed,
Zapped Again

Dear Zapped,

You're right, it isn't helping those tubes one bit. The cause is a dirty bandswitch. Take off the bottom of the rig and spray the switch's leaves with cleaner, then rapidly rotate the switch back and forth several times through all positions. While you're at it, spray and clean the variable capacitor behind the "plate" control the same way. By the way, Heath SB-220 amps are prone to the same problem.

Dear Kaboom,

My RTTY interface connects to the speaker output of my rig. It works, but I have to turn it up fairly loud sometimes for good print, and it drives me nuts! Is there any way I can increase the sensitivity?

Signed,
Headache #122

Dear Headache,

Yup, it's easy. Go to Radio Shack and get a miniature audio output transformer (catalog #273-1380) and a couple of 5 volt zener diodes. Connect the 8 ohm side of the transformer to the speaker output of the rig, and connect the diodes back to back (in other words, in parallel but opposite polarity) across the 1000 ohm side. Then connect the 1000 ohm side to the RTTY interface. The sensitivity should go up tremendously, and it's cheaper and safer than lots of pain relievers! 73

Number 31 on your Feedback card

Dx

Hams Around the World

Chod Harris VP2ML
PO Box 4881
Santa Rosa, CA 95402

Packet DX Spotting Networks

What does VHF FM packet radio have to do with DX? Everything, thanks to the innovative DX spotting software from Pavillion Software (PO Box 803, Hudson, MA 01749).

Dick Newell AK1A, who developed the software, has produced two different versions: one for small, local networks, and another for large networks capable of handling hundreds of DXers simultaneously, over thousands of square miles. These PacketCluster packages add a new dimension to tracking DX.

Packet Conference Bulletin Board

The stand-alone version, Packet Conference Bulletin Board (PCBS), runs on an IBM PC/XT or compatible computer, with a hard disk drive. This node, or central station, also needs a Kantronics KPC-2 terminal node controller (TNC) and a VHF FM transceiver, plus antenna, coax, etc., and a copy of the software. Most PCBS systems operate on 2 meters. The hardware commitment for the node is substantial—at least $1000 when starting from scratch. A local DX club may be able to find used radio gear, however, and also borrow a computer that would otherwise be idle, such as during non-business hours.

Fortunately, the individual DXer needs only a minimal packet system consisting of a suitable VHF FM radio, any model TNC, and a terminal, to get the system up and running. Older, crystal-controlled FM rigs, and inexpensive, surplus computer terminals are easy to find at hamfests, and the cost of a new TNC has dropped to only about a hundred dollars.

What does PCBS do for the DXer? A lot! The main function of the software is to store, organize, and disseminate detailed reports of DX stations, including callsign, exact frequency, time and date, the call of the station making the announcement, and a short note. The note might be QSL information, operator name, listening frequency, etc.

Any user of the system can enter a DX spot by simply typing in the DX station's callsign and frequency (and note, if any) into his or her terminal: DX/VP2ML 28495 QSL K1RH. The central computer logs and acknowledges the spot, adds the current time, date, and call of the spotting station, and immediately forwards the information to every other station connected to the system. If their equipment permits, users can set a bell to ring when the spot comes in. On a busy evening, the bell will ring continuously.

Even better, the central station node stores each DX spot indefinitely. This means a station doesn't need to be connected to the system at all times. A DXer can log into the system and ask for the last 5 DX announcements (or any number of DX spots, for that matter). The individual DXer can also specify a particular band, and get only those reports from that band. Want to know what's been on 160 meters the past week? Type SHOW/DX/24 160 for the last 24 DX spots on Top Band! DXers can even specify a particular country in their request: SHOW/DX VP2M will give the last five DX reports from Montserrat, including callsign, frequency, date and time, and logging station.

In addition to this DX spotting function, PCBS will provide beam headings for any country, give today's sunrise and sunset times for any country, and even predict the Maximum Usable Frequency (MUF) for a given path! Users can also enter and access WWV propagation data. Finally, PCBS contains regular packet bulletin board features, including the ability to talk to any connected station directly, and to store and retrieve mail, messages and DX bulletins, such as the contents of W1AW's DX bulletin.

This sophisticated software asks for the operator's name and location, then the data is accessible by any local user. Hear a callsign and want to know the operator's name and town? Type SHOW/USER (Callsign) and PCBS will tell you. Another innovative feature is the EXCLUDE function, which is very useful for contesters in the single-operator category. Because of some controversy over single-operator status for stations using DX spotting nets (they are *not* single operator, and are automatically reclassified as multi-operator entries), PCBS's EXCLUDE function can prevent the flow of DX information *to* a given station. That station can continue to feed DX spots *into* the system, to help those operators entering the contest in a multi-operator category, but the single operator does not receive any information back. And this EXCLUDE function is controlled by the system operator, not the individual contester, eliminating violations of the honor system.

The node operator ("sysop" in packet lingo) can add specialized data bases to the software, such as names and contest scores of local club members, oblast' lists, DX news filed by prefix, and whatever else would be useful for club members.

PacketCluster

PCBS is limited to a maximum of 26 users at a given time, a limit imposed by the TNC. Also, distant stations may have to use more than one digipeater to access the

SH/DX/20 10

28510	YC0MCA	10-Oct-1988	0309Z	good sig.	<K2ITG>
28525	HL2IDJ	10-Oct-1988	0238Z		<N6SKF>
28494.8	BY8AC	10-Oct-1988	0226Z	Calling CQ USA	<KD6PY>
28509.6	YC0MCA	10-Oct-1988	0224Z		<N6SKF>
28450.3	HL9OB	10-Oct-1988	0224Z		<K6PBT>
28450	HL9OB	10-Oct-1988	0220Z		<N6SKF>
28449.9	3D2YL	10-Oct-1988	0216Z	Karen	<K2ITG>
286039	KX6BU	10-Oct-1988	0035Z		<WJ6O>
28026.1	PU1L1U	10-Oct-1988	0005Z		<NC7K>
28033	BY4RB	9-Oct-1988	2353Z		<N6JV>
28492.8	KD7P/KH2	9-Oct-1988	2327Z		<WJ6O>
28502.2	4U43UN	9-Oct-1988	2237Z	New York	<KJ6LD>
28024	OA4ZV	9-Oct-1988	2146Z		<N6JV>
28007.6	CU2BU	9-Oct-1988	2114Z		<N6JV>
28456	AX4ABX	9-Oct-1988	2112Z		<N6SKF>
28522.4	ZY0TT	9-Oct-1988	2056Z	QSX 28553	<K6AYA-15>
28522.3	ZY0TT	9-Oct-1988	2051Z	listening 28550 up	<K6PBT>
28487.8	WY5L/KH3	9-Oct-1988	2035Z		<KD6PY>
28509.0	5H3RB	9-Oct-1988	1855Z	ROEL	<WA6HAN>
28039	GU0FYR	9-Oct-1988	1841Z		<N6JV>

Figure 1. The results of typing "SH/DX/20 10."

```
PacketCluster Configuration:

PacketCluster node: (WG6H-1)

PacketCluster node: (K6LLK)
(WA6ALZ)      K6SIK         WB6JXU        W6XB          (K6TMB)

PacketCluster node: (KN6J)
W0YK          (WA9WYB)      N6JL          (KJ6FD)

PacketCluster node: (W6LEH)

PacketCluster node: W6GO
(K6PBT)       (WG6P)        WA7G-6        (WA6OEC)      WA6JCD-15     K6YK

PacketCluster node: (W6OAT)
WD6CJB
```

Figure 2. The PacketCluster Configuration display, showing both the nodes and the stations connected to same.

SH/WWV/10

Date	Hour	SFI	A	K	Forecast	
11-Oct-1988	04	179	46	5	low-moderate/active	<WN6W>
10-Oct-1988	00	176	16	1	Low/Unsettled	<KD6PY>
9-Oct-1988	17	174	7	4	Low/Unsettled	<KD6PY>
9-Oct-1988	15	174	7	4	low/unsettled	<WN6W>
9-Oct-1988	01	174	7	1	Low/Unsettled	<KD6PY>
8-Oct-1988	18	174	7	3	Low/Unsettled	<K6PBT>
8-Oct-1988	03	181	7	1	Low, Quiet	<W6OAT>
8-Oct-1988	01	181	7	1	Low, Quiet	<W6OAT>
7-Oct-1988	19	181	7	2	Low-Mod/Quiet-Unset	<WA9WYB>
7-Oct-1988	18	181	7	2	Low-Mod/Q-Unsettled	<K6PBT>

SH/DX

21291.8	UB4MRG	11-Oct-1988	1512Z	CLG CQ	<WA9WYB>
21246	ON4VN	11-Oct-1988	1510Z		<WA9WYB>
21235	UA6LBH	11-Oct-1988	1509Z		<WA9WYB>
14182	VU2DNL	11-Oct-1988	1451Z		<WA9WYB>
14164.5	HK0EOU	11-Oct-1988	0633Z	SANANDRES	<WA9WYB>

Figure 3. The results of the command "SH/WWV/10," and of SH/DX (the last five spots, regardless of band).

Continued on page 93

AERIAL VIEW

Antenna News

Arliss Thompson W7XU
RR 3 Box 224
Sioux Falls, SD 57106

Simple Antennas for 17m

In 1979 the World Administrative Radio Conference (WARC) promised amateurs access to three new HF frequency bands. They were in the neighborhood of 10.1, 18.1, and 24.9 MHz, commonly known as the 30, 17, and 12 meter bands. US hams gained access to the 30 meter band in October 1982, and in 1985 were allowed to move onto the 24 MHz band.

The FCC has withheld the 18 MHz band from us for nearly ten years, but we may very well be allowed to operate on that band by the middle of 1989. Conditions on the HF bands have improved considerably from what they were a couple of years ago. The 18 MHz band should provide many interesting openings, plus the thrill of operating on a new band. But, while many of us own transceivers that will be ready to go when the FCC finally opens 17 meters, few of us have antennas for that band. Now is the time to start considering what sort of antenna you will be using when the first US amateur signals appear in the 18.1 MHz band.

Make Do?

Perhaps the easiest solution is to use an existing antenna designed for another band. Whether or not this gives good results varies with each individual installation, but in general a coax-fed dipole cut for another band will not be a good performer on 17 meters. Even if you use an antenna tuner to provide a reasonable match between the transceiver and the feedline, the resultant high SWR on the coax will be associated with high feedline losses. If you're using a coax feedline, a high SWR will also dictate low power. In short, while you might be able to squeak a few contacts out of such a setup, it would be far from ideal.

All-Band Antennas

If you enjoy operating on all the HF bands, but have room for only one antenna, you may already be using a multiband wire antenna. The most common examples of this type of antenna are end-fed wires (Figure 1) and open-wire, center-fed dipoles (Figure 2). Both of these, when used with an antenna tuner, gives good multiband performance. Unlike the coax-fed dipole operating far from resonance, a dipole fed with open-wire line can be quite efficient. The losses associated with a high SWR and open-wire line are typically much less than they are with coax operating under the same conditions. This means that the open-wire, center-fed dipole you may have been using on the 80 and 40 meter bands will also work well on 17 meters by merely retuning your transmatch. If the antenna is over 26 feet long, it will even show some gain at 18 MHz. If you want to operate on all or many HF bands, but you have limited space for antennas, the center-fed dipole deserves serious consideration.

End-fed antennas, including directly-fed antennas may give a good account of themselves in multiband use, although my experience with them is that they commonly produce only mediocre results. Moving to 18.1 MHz with such an antenna requires only the retuning of the matching network. If RF feedback should arise (a common malady associated with end-fed antennas), you can cure it by improving the grounding. Attach a ¼-wavelength long wire (about 13 feet for the 17 meter band) to the transmitter to serve as an artificial ground. This causes a low impedance condition at the transmitter, so any RF feedback problems should disappear. Do not attach this artificial ground wire to actual ground; just run it around the shack or hang it out the window above the earth. Attaching it to another grounded wire will upset its quarter-wave resonance and nullify its beneficial effect.

Another problem that arises with end-fed antennas, which are relatively long for the band you select, is directivity off the end of the antenna. That may be fine if the antenna is horizontal, but if a substantial portion of the antenna is vertical, much of the radiated signal may be wasted. This will be particularly true when you're operating at a frequency as high as 18 MHz, where most signals arrive at a fairly low angle of radiation. By the same logic, "force feeding" your low-band vertical to allow operation on the higher HF bands will probably not yield good results.

The Dipole

While many of us enjoy the benefits of yagis or other gain-producing antennas when operating on the 20, 15 and 10 meter bands, a simple dipole (Figure 3) can be a good alternative when moving to a new band. When US hams finally get onto 17 meters, most will be using compromise antennas and few will have beams. If you have only a dipole, you won't be at a serious disadvantage compared to the rest of the stations operating on that band. In fact, more than a few DXCCs have been earned even on 20 meters by stations using no more than a dipole. For best results, the antenna should be mounted at least ½-wavelength (roughly 30 feet for 18 MHz) above ground to achieve a reasonably low angle of radiation. You may feed the dipole directly with 50Ω coax, or you can install a 1:1 balun at the feedpoint, if you desire. An alternative to the balun is to coil a few feet of the feedline into a circle 4–6 inches in diameter at the antenna. Five turns should do. This serves as an RF choke and thereby reduces the odds of unwanted RF currents flowing on the outside of the coax.

The Ground Plane

Another old standby on the higher HF bands is the ground plane antenna (Figure 4). This antenna provides omnidirectional coverage and, when mounted well above ground, a low angle of radiation. For 18.1 MHz the vertical portion of the antenna should be 12' 11" long. You can make the radials (usually four) 5% longer. If you bring the radials off at a down-sloping angle, say 45 degrees, the feedpoint impedance of the antenna rises to approximately 50Ω. Even if you run the radials horizontally, however, you may feed the antenna directly with 50Ω coax and still not cause a serious mismatch. You could also feed the antenna through a ¼-wavelength transformer of 75Ω coax to improve the match to 50Ω coax.

Summing Up

These are some ideas for getting an antenna onto 17 meters. You may want to get an antenna up now and listen on 17 meters to see who is operating there. Remember, of course, not to transmit on that band until specifically authorized to do so, even if you hear foreign amateurs operating there (some foreign governments already allow their hams to use the band).

See you on 17!

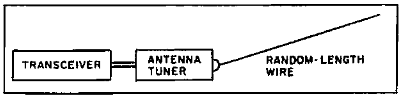


Figure 1. End-fed random length wire.

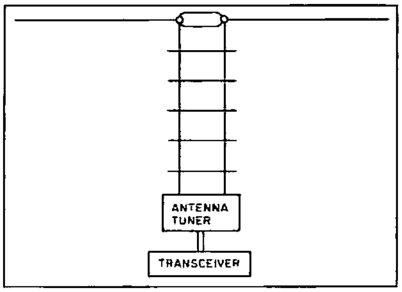


Figure 2. Open-wire, center-fed dipole. Minimum dipole length will vary with the lowest frequency. For operating at 3.5 MHz and higher frequencies, the dipole should be at least 66 feet long.

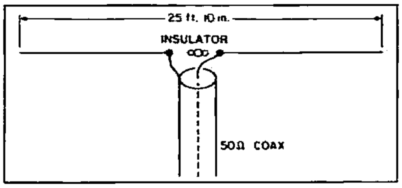


Figure 3. Coax-fed dipole for 18.1 MHz operation.

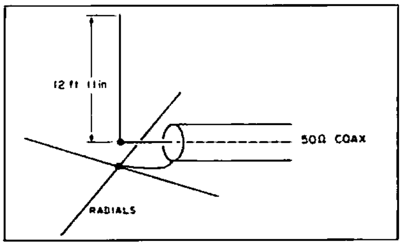


Figure 4. Ground plane antenna. The 4 radials are each 13' 11" long. For improved match to 50Ω coax, the radials may be angled downward. Insulate the ends from ground.

Number 30 on your Feedback card

NEW PRODUCTS

Compiled by Linda Reneau

PRODUCT OF THE MONTH

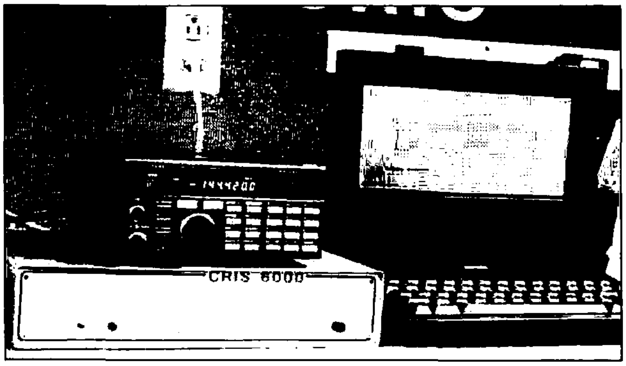
PacComm TRANSCEIVER REMOTE CONTROLLER

The Model RCH-1000, PacComm's Transceiver Remote Controller, has a remote control head (2.25"x7.38"x1"), speaker enclosure, transceiver interface box, and Interconnecting cables. The remote head has tuning and volume control, LCD frequency display, 100 memories, 15 other parameters, and a 12-key function keypad.

The unit's software supports all popular transceivers. The Model RCH-1000 provides mode change, memory selection and update, and A and B VFOs, including splits.

Accessories include: fixed-site installation kit; mobile Installation kit; marine installation kit; and non-standard interconnection cable lengths. Suggested retail price, $395. For more information about the features and specifications of the Model RCH-1000, contact *PacComm in Tampa, Florida, at 813-874-2980.*

CIRCLE 201 ON READER SERVICE CARD



CIRCLE 202 ON READER SERVICE CARD

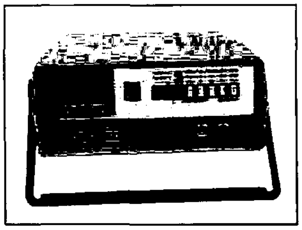
EEB

EEB's portable Computer/Radio Interface System, CRIS 6000, operates a variety of radios and greatly simplifies radio operation. Hardware consists of an interface box with cabling to the computer's serial port and the radio. Read up to 800 memory channels, edit RAM channels with built-in editor, write RAM channels to disk or radio memory, set mode and frequency to current RAM with a single keystroke. You can scan, and use four step sizes. You can log data quickly. The CRIS 6000 requires a few mA at 12 V DC.

CRIS software will be updated to support new radios and features. Its multi-tasking software is written in 'C' and assembly language. To use CRIS 6000, you need an IBM or compatible, with a serial port and at least 256K memory; a CRT, DOS 2.11 or later, and optional printer. Price, $349.95. Contact *EEB, 516 Mill St. NE, Vienna VA 22180. 703-938-3350. FAX: 703-938-6911. Orders: 800-368-3270.*

Aries-1™ Correction

Please note that the price of the Product of the Month in the January issue of 73, Aries-1,™ a terminal and contest program, was incorrect. The correct price is $89.95. My apologies to Ashton ITC.—L.R.



CIRCLE 203 ON READER SERVICE CARD

ELENCO ELECTRONICS, INC.

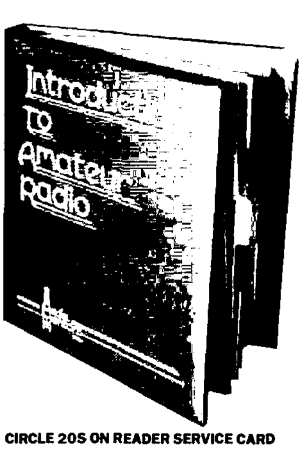
New from Elenco is a versatile 4½ digit portable instrument suitable for general electronics maintenance, production, and research. The Digital Bench Multimeter Model M-4500 has a built-in battery pack which provides 6,000 hours of continuous operation. It features 0.05% DC volt accuracy, integrated circuit electronics, solid-state LCD display, and push-button switch selection. All VOM functions, plus the versatile diode test and high–low ohm test functions, are included as standard. Each range has full auto-polarity operation and overrange indication. it uses the dual-slope integration measurement technique to insure noise-free measurements. The Digital Multimeter comes with operator's manual, test leads, and battery pack for $250. *Elenco Electronics, Inc., 150 West Carpenter Avenue, Wheeling IL 60090. 312-541-3800. FAX: 312-520-0085.*

AZIMUTH

Azimuth's WeatherStar Model TWR-3 by Digitar lets you monitor important local weather conditions affecting your antenna system and shack. The TWR-3's stand-alone computer with ⅜" LCD readout gives you wind direction (2- or 10-degree increments) and wind speed. It records high wind gusts, external temperature, wind chill, low and high temperatures, daily and yearly rainfall with optional self-dumping rain collector ($49.95). Scan Mode lets you see the data in any sequence. Lab accuracy is plus or minus 1%. Operates on three AAA batteries; AC adapter optional. NiCad Battery Pack and desk stand available.

The portable WeatherStar Model TWR-3 comes with wind vane, high-impact anemometer, UV resistant plastic, computer unit, and a 40-foot control cable. Price, $159.95, plus $4.95 S/H. For foreign orders, add $17 for shipping. Special free bonus: Azimuth Dual-Zone 24-hour Station/Travel Clock ($29.95 value). Contact *Azimuth WeatherStar, Dept. 73, 11845 W. Olympic Blvd., Suite 1100, Los Angeles CA 90064. Information, 213-473-1332. Credit card orders, call 800-882-7388.*

CIRCLE 204 ON READER SERVICE CARD



CIRCLE 205 ON READER SERVICE CARD

Media Mentor, Inc.

Carole Perry WB2MGP, creator of Media Mentor, Inc., has taught ham radio to hundreds of young people in the past eight years. She has used amateur radio to inspire and challenge her sixth, seventh, and eighth grade students to enrich their knowledge of electronics, science, math, communications, geography, and other cultures.

Carole WB2MGP has now packaged her expertise in *Introduction to Amateur Radio*. The package includes a Complete Instructor's Manual with twenty-six lesson plans; an audio cassette for code practice; a code practice oscillator; a free videotape illustrating classroom instruction using this curriculum; and access to *Ham Radio Hotline* for customer support in using her package. The entire package is $99.95. Extra Space Code cassettes are $6.95 each, and the Code Key 1000 alone is $19.95. Quantity discounts. *Media Mentors, Inc., PO Box 131646, Staten Island NY 10313-0006. 718-983-1416.*

BARTER 'N' BUY

QSLs TO ORDER. Variety of styles, colors, card stock. W4BPD QSLs, PO Drawer DX, Cordova SC 29039. BNB260

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SUPERFAST MORSE CODE SUPEREASY. Subliminal cassette. $10. LEARN MORSE CODE IN 1 HOUR. Amazing new supereasy technique. $10. Both $17. Moneyback guarantee. Free catalog: SASE. Bahr, Dept 73-2, 2535 Marietta, Palmbay FL 32905. BNB531

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Low Power Operation

Mike Bryce WB8VGE
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Heat Up the Iron

What fun! Snowed in and nothing to do! Well, have you given any thought to making some changes to your shack's radios? There is no time like the present. Let's take a look at some simple little mods for some of the more popular Heath series radios, namely the HW-8 and the HW-9 QRP transceivers.

The HW-8 continues to be a hard act to follow. There is no end to the modifications that we hams can come up with for this radio. The newer HW-9, after a few years on the market, is also coming under the gun of the QRPers' soldering irons. So let's heat up the iron, remove the screws from the HW-9, and jump right in.

Bright ideas

In my shack, I like to know if something is on or off. My source of power is the sun, so I don't like to waste energy. Of course, neither the HW-9 nor the HW-8 has a "power on" indicator. In the HW-8, the most popular method of using a "power on" indicator is to back-light the meter by mounting a small grain-of-wheat bulb behind the meter. The meter will take on a nice soft glow.

I tried the same method on the HW-9. Guess what? It didn't work! Seems that this time around Heath has painted the back of the meter, and you can't get a light bulb to shine through. Rats!

Not being one to give up easily, I took a closer look. If you have an HW-9, remove the top case. Notice that the front panel and the inside chassis are two different pieces. Notice also the small gap between the two. Whoa! Right there is the place to install some small lights to illuminate the meter. In fact, there is room enough for a second lamp for the dial!

My junk box seemed to lack anything in the way of grain-of-wheat bulbs, so I went to the local Radio Shack. Looking over the stock that was hanging on the pegs, I came upon a pack of multicolored miniature lamps, 12 volts or 6 volts, for under two bucks per pack.

I removed the colored paint with a dab of fingernail polish remover, then I applied a small drop of Superglue™ to one side of the bulb. I mounted the bulb between the two panels just above the meter face. I also installed a second lamp just above the dial, being sure to center both lamps.

Since I had picked the 12 volt units, I wired them in parallel and ran a small piece of wire from the top side of the HW-9 to the power switch on the bottom. I followed the routing of the main cable harness leading to the bottom board. I found that the lamps generate quite a lot of light, with little heat build-up. To prevent the bulbs from being smashed if the front panel were pushed in, I installed a small rubber "foot" on the left side of the meter. This rubber "foot" acts like a shock absorber, protecting the lamps.

With both lamps running, they will draw an extra 100 mA or so. If you plan to operate the HW-9 via battery, you might want to consider installing a switch on the rear panel to turn off the lights. Also, when working with the Superglue™ be **EXTREMELY** careful when installing the lamp over the dial. You don't want to get any of the glue down inside the dial or the dial drive.

If the lamps are a bit too bright for your liking, just add a current-limiting resistor in series with the bulbs. Be sure to keep that resistor away from the heat-sensitive circuits inside the HW-9.

Audio Fixes

Now that we have some dial lights, how about two simple fixes for the audio? While you're at Radio Shack, pick up a speaker for the HW-9. It's a Radio Shack Minimus −0.03, catalog number 40-1250. I added four large rubber feet to the bottom of the speaker. The speaker is now just as high as the HW-9. The dark walnut color matches quite well with the HW-9. The speaker sounds great, and is a lot cheaper than the Heath speaker.

There is a drawback to this "fix." If you're like me, and Rod Breaux WA5OIH, you'll notice that the audio sounds "kinda funny." Rod tracked the problem down to C336 on the T/R board. Capacitor C336 couples the product detector U303 with the low-pass filter U304B. The capacitor value is not especially critical and any unit of 10 µF or less, with a voltage rating of 15 volts or more, will work fine. In my HW-9, I installed a 4.7 job and had great results. The "fix" here is to install a new capacitor, but install it **BACKWARDS** from the original way. Heath designed the circuit in reverse polarity. You'll get an increase of audio, providing a significant improvement in the signal-to-noise ratio.

Increasing Output

We now have meter and dial lamps, and better audio. How about increasing the punch of the transmitter a bit? Again, Rod comes to the rescue.

To correct for low output on 10 and 15 meters, Rod changed capacitors C563 and C566, using Arco trimmer capacitors, and made them variable. Keying the rig into a dummy load, adjust the trimmers for maximum power output. After you're done, measure the value of the trimmers and substitute silver micas for the trimmers. You'll gain 1 to 1½ Watts on 10 and 15 meters. You don't have to mess with the filters for the other bands.

The driver stage, Q404, uses inverse feedback in the form of R414 and C432. To get more drive, you increase the value of R414. Be careful—too much gain and you'll have instability in the stage. Rod suggests that you start off with 1.8k ohm and increase the resistance in steps. His HW-9 remained stable at 3.3k. I stopped at 2.7k and had a power increase to about 5 Watts on 80 meters. This modification has little effect on the higher bands, so monitor your success on 80 meters. In working with a stage with such a high FT, the transistor can become very unstable. The front power control should provide smooth output with no sudden pops or sluggish responses.

The final modification to the driver stage is to remove resistor R415 with a jumper and a ferrite bead. Again, watch for signs of instability. By careful selection of components, you'll be able to have in excess of 6 Watts output on 80 meters. Just remember, if you want to operate within the contest rules of the QRP International, you can't have an output over 5 Watts.

Drift Fixer

Seems that every HW-9 has some drift problem. My HW-9 is not too bad, and to be frank, I never worried much about it. But Rod did, and here is his fix for VFO drift.

Remove the shield can and arrange the components so that none touch each other or the shield can when it is replaced. This includes the VFO coil L118. Bend the top of the can if necessary to allow coil clearance. This is an easy fix. Also, I've been told (but haven't tried this one myself) that you should paint the inside of the shield black. This keeps drift down. It seems that the black paint will absorb the heat, and thus prevent any effects on the components.

If you still have the cover off, solder a small piece of flexible conductor (RG-174 braid, solder wick, etc.) from the tuning capacitor shield to the ground lug of adjacent AF control R3. The grounding provided by Heath is a bit lackluster!

A Simple Adjustment

When I do a modification on a radio, I always like the ones that require only an adjustment of this or that. The transmit offset adjustment is just that, an adjustment. You'll need another radio, and not the HW-8 or another HW-9. Connect the regular station radio to a dummy load. Set it up for normal CW operation and switch in the sharpest IF filter available. Next, key the rig and peak the signal in your HW-9. Be sure to have the selectivity switch in the "narrow" position. Now, unkey the station rig and key the HW-9 also into a dummy load. While it's keyed, turn R131 on the oscillator board until the signal peaks in the station rig.

That's it! You've just set the transmit offset of the HW-9. Now, when you work a contest, those ops with the super high-tech filtered rigs will be able to hear you.

There are more mods for the HW-9. And, as more and more of the QRP ops take the time to change and modify the HW-9, the list will grow. I'm in the middle of working on the third edition of the Hot Water Handbook. If there is some modification that you deem important, please drop it my way. If I use it, you'll get a free copy of the HW Handbook when it is done.

Remember, this is your column. I need your input to keep up with what you want to read about. I can always use photographs, schematics, and other goodies to share with our readers. 73

HOMING IN

Radio Direction Finding

Joe Moell PE KØOV
PO Box 2508
Fullerton, CA 92633

Let's Build a Quad

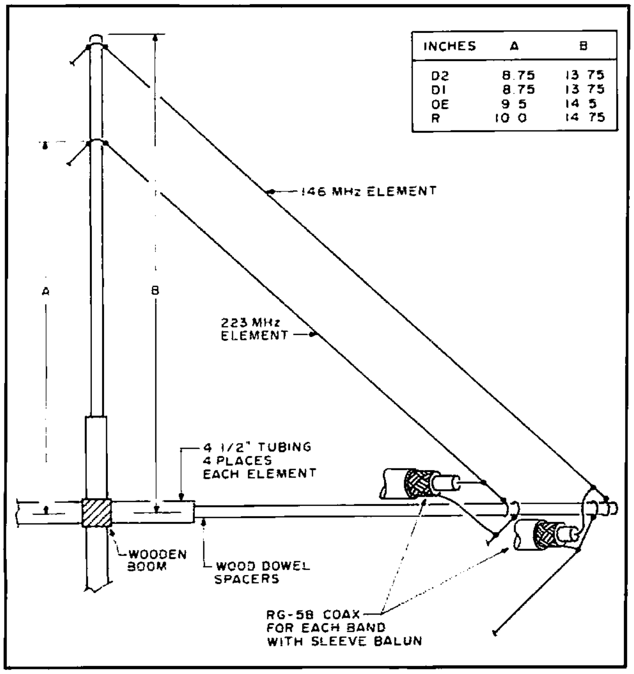
Last month I explained why gain antennas such as yagis and quads are preferred by the best southern California transmitter hunters over all other methods for competitive hunting on the 2 and 1-1/4 meter bands. Gain antennas save the day when the signal is weak, as it is when the hider runs low power from the valleys, canyons, and (occasionally) the sewers of the Los Angeles basin.

Despite all its advantages, a quad DF setup isn't expensive—in fact, it's dirt cheap and you can lash it up yourself even if you're the kind of ham who has buildophobia. Parts are no problem even if you're miles from a radio store because you get them from your local lumberyard or hardware emporium.

This dual-band quad was developed for hunting by the late Ray Frost WA6TEY, and documented by K6BMG, N6JSX, and others. It uses 18 or 19 AWG wire strung in a diamond configuration like the photo in last month's column. If you aren't interested in hunting both bands right now, install the elements for only your band of interest.

There is an endless variety of ways to put together a strung-wire quad. WA6TEY used a wooden boom (1-3/4 X 1-3/4 X 28 inches long) and spreaders of 5/16 inch wooden doweling held in place with 4-1/2 inch lengths of 3/8 inch hard aluminum tubing from an old TV antenna. Others have built their quads with PVC pipe booms and fiberglass rod spreaders. Just remember that the boom and spreaders should be non-metallic and the mast/boom coupling should allow boom rotation to select horizontal or vertical polarization, if both are used in your area. Figure 1 shows the coax connected for vertical polarization. For horizontal polarization, the feed should go to the bottom corner.

The directors and reflectors are continuous wire loops. Break the driven element loops at the feed points and connect them to the shield and inner conductor of the coaxes as shown. To decouple the feed line, use a sleeve balun made of braid from an old piece of coax. Remove the outer jacket on the 2 meter coax 13-1/4 inches from the driven element end and solder one end of the sleeve there. Smooth the shield sleeve down over the jacket of the coax and trim it off a quarter inch from the driven element end. For 220 MHz, use a similar sleeve connected 8-5/8 inches from the driven element end. Put tape or shrink sleeving over each balun.



INCHES	A	B
D2	8.75	13.75
D1	8.75	13.75
DE	9.5	14.5
R	10.0	14.75

Figure 1. Element details of the dual-band quad. Elements are symmetrical and only one quadrant is shown. Holes to string the wires are at distances A and B from boom center on each spreader, per the table.

Be prepared to spend some time tweaking your antenna for best performance. Don't permanently fasten the spreaders to the boom or install the jumpers holding the element wires to the spreaders until you have completed your adjustments. Install the director loops first, then connect the driven element loops to the feedline, and adjust their lengths for best SWR on each band by moving the connection points of the feed line. Install reflector loops and adjust reflector and driven element lengths for best SWR.

Now set up the antenna on your vehicle in a wide open field or large, empty parking lot. Use a signal source a hundred feet or so away and check for left or right bias in the antenna pattern when DFing the source. If the quad points to the right of the source, redistribute some of the wire of the driven element for that band to the right side of the spreaders. If the pattern is biased left, redistribute wire to the left. After you have eliminated the bias on both bands, attach the element wires and secure the spreaders in place inside the aluminum tubing with crimping, setscrews, or glue.

Seal off the ends of the coax and paint your completed quad a dark color. That protects the elements and makes the setup inconspicuous on night hunts. When hunting on 2 meters, be sure to terminate the end of the 220 MHz coax with a 50Ω load, and vice versa. Otherwise, element interaction may skew the pattern.

Beams Aren't Perfect

It should come as no surprise that there's no VHF DF system that's best for all situations. Beams do have their disadvantages on mobile hunts. They're cumbersome, particularly if you have to get out of the mobile and hunt on foot to close in. That full-size yagi or quad can get pretty heavy after a few hundred yards!

Beam hunters must remember to swing the beam in a full 360 degree circle regularly, or they may miss a sudden shift in signal to the rear as the hidden T is passed. For this reason, beam hunting works best when there are three hunters in the car. The driver concentrates on the road, the DFer swings the beam and gets bearings, and the navigator watches the maps.

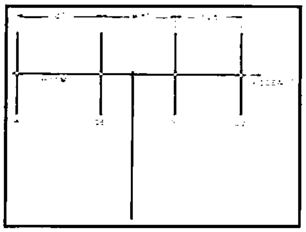


Figure 2. Side view showing how the elements are located on the boom. Elements are the reflector (R), driven element (DE), and two directors (D1 and D2).

Beams have good directivity and front-to-back characteristics only over a relatively narrow frequency range. A 2 meter quad won't work well for aircraft search and rescue on 121.5 MHz or on the VHF marine band. You need a separate beam for each band where you want to hunt.

Most mobile hunters use three or four element yagis or quads on 2 meters because longer ones get too unwieldy at high speeds. The trade-off is that short beams are too broad to give high resolution. The 3 dB beamwidth of a four element quad is more than ± 30 degrees, requiring careful aiming to determine where the exact signal peak is. It's even harder when there are mobile fluctuations.

There are even a few hunting situations when the beam/S-meter method works so poorly it can drive you crazy. A good example is the hunt put on at the 1986 ARRL National Convention in San Diego.

Instead of transmitting continuously, the fox went on for a half-second, then off for a half-second, over and over. As if that were not tough enough on hunters trying to get signal strength readings with a bouncing S-meter, the automatic transmitter controller set the output power to a different randomly-selected level (from a hundred milliwatts to a hundred Watts) for each half-second burst.

When signal strength information is more confusing than helpful, a RDF system which does not depend on relative amplitude is needed. Such systems exist, and they have other advantages as well. We'll begin discussing them next time. ■

73 INTERNATIONAL

edited by C.C.C.

INTERNATIONAL INDEX FOR 1988

(Includes "Roundup" and "Notes from FN42" references)

Notes from FN42

*The Index (International) for 1988 is in two parts. For an index by nations, see box; an index by major subjects is here: Esperanto—July; World—ITU items, July, November; **Universal Permit Application**—January, February, March, October. (For the index by nations for issues from April 1983 through 1987, see page 97 in the January, 1988, issue.)*

Ambassador *Barry* **Goldwater** *K7UGA—courtesy of Advanced Electronic Applications, Inc. (see photo). Barry received the third annual Amateur Ambassador Award from AEA at the ARRL National Convention last September. The $1,000 check which came with the award was immediately endorsed over to the ARRL by K7UGA, where it will be applied to the Fund for the Defense of Amateur Radio Frequencies. Nominations for the 1989 award (which is international in scope) may be made on forms available from AEA, PO Box C2160, Lynnwood, WA 98036-0918, USA. Nominees are judged on the criteria of dedication to amateur radio, positive influence on those outside the amateur service, and initiation of special projects or programs to promote the amateur service. Previous winners were Mary Duffield WA6KFA and Byron Lindsey W4BIW.*

February calendar: 2—Groundhog Day, USA; 4—Independence Day, Sri Lanka (7th for Grenada, 18th for Gambia, 22nd for St. Lucia, 27th for the Dominican Republic); 5—Anniversary of the Constitution, Mexico; 6—New Zealand Day (Watangi); Tet, Vietnam; Chinese New Year (Hsin Nien)-Year of the Snake begins; 8—1968 Revolution Day, Iraq; 11—Commemoration of the Founding of the Nation, Japan; Youth Day, Cameroon; National Holiday, Iran (23rd for Gambia and Brunei, 25th for Kuwait); 14—Valentine's Day, Race Relations Day, USA; 18—Democracy Day, Nepal; 19—Brotherhood Week begins, USA; Mothering Day, Great Britain; 20—Lantern Festival, China; President's Day, USA; 22—Washington's Birthday; 25—Victory Day, Czechoslovakia; 28—Kalevala Day, Finland.

Barry Goldwater (right) receives the 1988 International Amateur Ambassador Award from Mike Lamb N7ML, President of AEA, Inc. See text for 1989 nomination process. (Photo by Bob Kuhn KC7YN)

Roundup

USSR. *Confused?* Some of the information about the new West Siberia DX Club and its new awards program has been confusing, some contradictory. We suggest you respond to this message received by us: "The club welcomes inquiries from individuals and other clubs worldwide regarding the Club programs and activities. Please direct inquiries to: USSR, 644099, Omsk-99, PO Box 836, West Siberia DX Club." [*NOTE: That's the order in which address units appear in the USSR. For the convenience of both US and USSR postal personnet, it is suggested that whatever order you use, place each unit on a separate line and print VERY carefully.—CCC*]

The latest information we have: It is not necessary to be a WSDX Club member to qualify for the awards. And see the boxes for information on the Arctic Ocean Award and a revised list of cities for the USSR 1,000,000 Cities Award reported on in last month's 73 International.

World: Esperanto. Fakuloj pretendas, ke preskaŭ iu ajn persono povas lerni Esperanton en cent horoj aŭ malpli. Yes, they do! *Who does what?* Experts, who say: virtually anyone can learn Esperanto in 100 hours or less.

How did YOU do (if you are one of the 33 who took advantage of the free-lessons offer made through this column)? *(July, 1988, p. 91)* The 33 were from 20 different states, including four Ohioans (Ohioers?), and at least one did all of the ten free lessons—will he/she write and tell us how it goes on the air? The offer is still open, according to Esperanto enthusiast Allan C. Boschen; and in response to comments made by some of the 33, a new compilation has been made of all words used in lessons 1 through 4 (accompanies lesson 2), lessons have been improved, and a tape is being prepared with lesson-conversations and songs, so one can learn what Esperanto sounds like. (A nominal charge, only for the tape, if requested, will be made.) If interested: Send a business-size SASE (SAE with IRCs if you write from outside the USA) to **Esperanto STI, 195 Partridge Road, Pittsfield, MA 01201, USA** for the first of the ten free lessons. Return each lesson for correcting, with another SASE (or SAE with IRCs) for the next one.

World: Asia Telecom 89. The International Telecommunications Union and Telecommunications Authority of Singapore are sponsoring "Asia Telecom 89" in Singapore, 20-25 February, with exhibition and forum at one place, in Raffles City, at the Westin Stamford and Plaza. The forums, workshops, and exhibits are for telecommunications specialists,

WESTERN SIBERIA ARCTIC OCEAN AWARD

Requires QSO/SWL with amateurs of the following (numbers in parentheses are oblast' numbers):

JW—Spitzbergen	UA1—FJL	UAØ—Severnaya Zemlya
Bear Island	Novaya Zemlya	Novosibirskiye Islands
JX—Jan Mayen	UA1N—(088)	Wrangel Island
KL7—Alaska	UA1O—(113)	UAØB—(105)
LA—Norway	UA1P—(114)	UA8K—(139)
OX—Greenland	UA1Z—(143)	UAØQ—(098)
VE—Canada	UA9K—(163)	

Three contacts with Soviet Polar Drifting stations (UPØL, 4KØ, etc.) may be substituted for any of the above.

Class I—20 contacts, no two with same area.
Class II—15 contacts, no two with same area.
Class III—10 contacts, no two with same area.

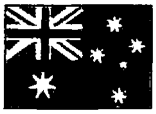
QUALIFYING CITIES FOR U–1 000 000–C AWARD

(See January 73 International USSR Report)

Alma-Ata	Kiev	Omsk (•)
Baku	Kuibyshev	Perm
Chelyabinsk	Leningrad	Sverdlovsk
Dnepropetrovsk	Minsk	Tashkent
Donetsk	Moscow	Tbilisi
Gorky	Novosibirsk	Ufa
Kazan	Odessa	Yerevan
Kiev		

(•) Omsk is required for any class of this award.

service providers and users, manufacturers, investors, and economists from around the world. The theme will be: Moving into the Information Age: Integrated Telecommunications Services and Networks.



AUSTRALIA

Following is Part II of the report sent in by Jim Joyce VK3YJ which we have entitled "Four Men and an Island—Weather from Beyond the Outback." Part I appeared in the December, 1988, issue.

Amateurs on Willis Island. One early amateur was John VK4JQ, who operated both phone and CW in late 1963. Mid-1964 saw VK4WV active on CW, and the DX column in the WIA journal, *Amateur Radio*, for November, 1967, notes that "Willis Island's John VK4HG [is] having a few minor troubles. On the last air drop his 10 and 15m gear went into the drink beyond the reef. So look for John now only on 20 SSB 0900 and 2000Z."

Gavin VK4EV (now VK3HY) spent some time on the island in 1968 and enjoyed around 1500 contacts while using a home-brew phasing-type transmitter with an output of 50 Watts PEP, to a ground plane on 20 meters, a half-wave dipole on 80 meters, and a two-element beam for 6 meters. His receiver also was home-brew. After his return home, Gavin received QSL cards direct and through the Bureau for nearly ten years.

Gavin's period of duty missed out on the cyclone season, but an earlier team had the stimulating experience of cyclonic winds clocked at 108 knots. This is still the record for wind strength in Eastern Australia, and the team was very happy to have the concrete bunkers built for such occasions, provisioned with basic necessities.

One popular amateur was Kevin VK9ZC (now VK4AKC). He arrived in 1973 with a new license, an FT-101, materials to make a quad, and lots of enthusiasm. The big opportunity for team members to talk with those back home made amateur radio an instant hit and a hobby for everyone there. In fact, the team relieved him of rostered duties for the 24 hours of the RD contest, with his promise that he'd stay on the mike. He endured, and the team waited on him hand and foot with nourishment and encouragement. The result? He won the VK9 segment of the contest!

Kevin had over 2400 DX contacts during his stay, even though many of them involved heavy going. Whenever he went on the air the whole world wanted to work him for a new country, and as he worked only transceive, it could take him up to 15 minutes to acknowledge one call. QSLs were handled promptly, however, as he transferred log data to his manager day by day. Kevin made friendships worldwide.

Willis Island—a sea-level view.

QSL TIDBITS FROM NT2X

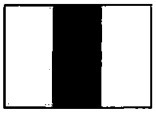
(See under USSR in "Roundup" for note on forms of address in the USSR)

Any who still need QSL cards from 4K1A, 4K1HK, 4K1ANO, 1980 to 1987, may write for them from USSR, 127349, Moscow, PO Box 459, Toivo Lamitainen RA3AR *** RA9YD willing to help obtain ANY Soviet QSL cards and send airmail. Send request with 3 IRCs to USSR, 656057, Barnaul, PO Box 2353, Valery Tyulyapin RA3AR *** UQ2GAG has the 4K1GAG operation logs. If in need of a QSL, send your card with 2 IRCs to USSR, 226010, Riga, PO Box 50 *** UW1ZC has the logs for the 4K1CEY operation. Mail your correspondence to USSR, 184360, Murmanskaya oblast', Kola, PO Box 70 *** Alex Vedernikov UA9YAB is willing to become a QSL Manager for any North American station or radio club and help facilitate QSL exchange between them and USSR stations. He has logs for UK9ZAA, UA9ZAA, UK9YBD/U9Z, UZ9YWA/U9Z, UZ9ZWA/U9Z, and can help with other QSLs. IRCs will be appreciated. Address: USSR, 659303, Altaisky Krai, Biysk, PO Box 83.

Kevin's popularity wasn't hurt any by his contribution to TV reception. His interest in VHF decided him that the spasmodic images from Townsville could be improved by a "VK9ZC Special," a 6-element yagi with a mast-head amplifier. Results were disappointing, so he constructed an 11-element yagi. Results were promising, but he estimated that at least another 10 dB of signal was needed for consistent viewing.

There followed a period of construction of antennas with exotic designs, and various longwires and vees, with enthusiastic help in their erection and testing. Finally, a stacked rhombic with a 200-foot-long axis won the day. TV viewing with watchable signals became possible about five nights per week, providing much entertainment to the population of lonely Willis Island.

[*The Willis Island story concludes with Part III, to come.—Ed.*]



CANARY ISLANDS
(Spain)

Woodson Gannaway N5KUB/EA
Apartado 11
35450 Santa Maria de Guia
Las Palmas de Gran Canaria
Islas Canarias, Spain

The Canary Islands are a group of seven normally recognized ones and several smaller, seldom mentioned islands. All are located close to the northwest coast of Africa. They form two provinces of Spain, and of course everybody speaks Spanish. Even if someone native to the islands can speak good English, it is really appreciated if you speak in Spanish. I find them very helpful in slowing down to accommodate my imperfect Spanish.

We have lived here over a year and a half, and I had my license to operate (temporary, good for one year) six weeks after applying. The process is pretty straightforward if you speak Spanish. I applied in person at the Telecommunications Office; it cost about 1800 pesetas (around US $15).

I had been advised to bring my rig; and I advise you the same, and bring it complete because you won't know what you can find if you need something. Part of the application procedure requires asking for permission from the *Communidad*, the building management committee, if you plan to erect an antenna in a part of your building other than your own apartment. If you apply by mail, you could perhaps plan a small vertical from the balcony. Allow lots of time if you apply by mail! But be sure to apply; this is a great place to operate!

Last July the amateur radio operators from the island of Fuerteventura travelled to El Hierro [*about 200 miles to the west, the most western of the Canaries—CCC*], on what was said to be the

first expedition away from the major islands. It was authorized by the General Director, Telecommunications, and the special callsigns, ED8EIH, EE8EIH, and EF8EIH were issued for use during July. A distinctive QSL card was made up.

NEW ZEALAND

Des Chapman ZL2VR
459 Kennedy Road
Napier
New Zealand

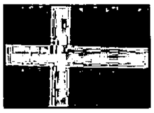
Kia ora atu i Aotearoa— Hello from New Zealand! Welcome to CCC as the new editor of 73 International!

I have submitted the specimen 73 International Universal Permit Application to the authorities for their perusal and suggestions and, I hope, approval. I have also sent copies to NZART Headquarters for Council comments. The form appears to cover all the present requirements listed in the ZL Visitor permit application form.

The term "user pays" seems to be rearing its ugly head in many places and countries now. I noted in a recent publication that the "sale of spectrum," the stuff we use every time we throw the big switch, was the subject of renewed efforts by President Reagan to charge "users" for access to the radio spectrum by making provision in the 1989 budget for "it" to be auctioned. However, from our point of view, amateur radio was protected because public safety services and Amateur Radio would be exempt.

Here in ZL we are facing the user-pay syndrome too, not the sale of spectrum although this could come, but with regard to the use of prime sites owned by organizations and companies where amateur radio has acquired rights to place their VHF/UHF repeaters—and now owners are seeking the right to charge annual rentals. If this works out and fees are high, it is probable that the number of repeaters will diminish accordingly. It is easy to look back at the good old days in ZL when the license was $6 and we had big hunks of spectrum for recreation "as of right," but we must look forward to the '90s and devise strategies to justify the hobby use of what others see as a saleable commodity. I think we can, but must continue to lobby and bargain from here on in... which brings me to my next point: WARC 1992. It seems that the ITU is expected to announce that a World Administrative Radio Conference will occur then. It is essential that all amateurs arrange for the best representation at Geneva to defuse the threats to our operating frequencies and even achieve better privileges. Such representation will not be cheap but it falls to us, the members of various leagues and associations throughout the world, to finance it. NZART has been placing funds aside for this purpose ever since the last WARC, and members and clubs are presently contributing to the WARC 1992 Fund. [*Hambassadors: what are your countries doing?—CCC*]

Christmas will have come and gone by the time you read this, but all of us from down under hope you—all the hams of the world—had a merry one, and may 1989 bring about hundreds of better QSOs among us all. I look forward to sharing some of these QSOs with you.



SWEDEN

Rune Wande SMØCOP
Frejavagen 10
S–155 00 Nykvarn
Sweden

A very limited permission to operate on a new band, 50 MHz, was given last June for the SM3-VHF Meeting in Ostersund. Successful SM contacts were made with PAØRDY, PA3ECU, PA3COB, PA3DOL, and LA6QBA, and also a tropo-QSO with LA1K. This opened up the possibility for authority to operate on this band in the future. There will be a trial period since we still have national television broadcasts in this band segment. There will be 25 licenses issued for the trial period, and by the time you read this these stations certainly will be on the air. You will have a good chance to work the Nordic countries as there already are over 60 licenses issued in Finland for this band. Good luck!

DXing is gaining in popularity in the Nordic countries. No longer are we only sitting at home working the rare ones. Now quite a few LA, OH, OZ, and SM hams are travelling the world and giving the demanding DX-world new countries worked and confirmed. The DX groups are arranging DX Meetings—inviting guests from far away as well as DXpedition members from home countries. In 1987, the big thing was, of course, Peter I Island, and both Einar LA1EE and Kaare LA2GV were popular guests, and they gave fantastic slide shows. In January of 1988 the OH DXers held a big meeting outside Helsinki. Martti OH2BH showed the video recording from the famous SØRASD operation, and John W2GD talked about his operations from P4ØGD. To make the most of it for us five SM visitors and for W2GD, the talks in Finnish were interpreted simultaneously into English—an unexpected and very much appreciated effort by the organizers!

The LA DX Group had its meeting in Geilo last June, with 22 Finnish DXers and visitors from nine countries. John ON4UN and Pekka OH1RY were among the attractions.

Lake Wettern DX Group SK6WW holds the Swedish DX Meeting annually in October. The last one met in Omberg, just south of Motala on the eastern side of Lake Wettern in SM5-land. Among others, Lars SM5CAK and Osten SM5DQC worked hard with the logistics. We have quite a crowd of DXers meeting on 3775 kHz every Sunday at 1000 local time to exchange news and QSL information. It really is nice to get together at least once a year to meet old as well as new friends. SM5CAK has for years gathered information on QSL managers and probably has the most complete collection; his information is always in demand.

Stu WAA2MOE gave a slide show from the recent Palmyra and Kingman Reef DXpedition. Erik SMØAGD brought the Abu Ail DJ6SI slide show with him, that can be borrowed from the Northern California DX Foundation (NCDXF). Unfortunately there was not time enough for Erik to show pictures from his S9AGD operation of last fall. Lars SMØGMG brought the SØRASD video tape and Tord SM3EVR showed a video presentation on how packet radio can be used also by DXers. Erik W6DU gave a presentation of the NCDXF that has made many DXpeditions possible. SMØAGD was busy signing up DXers to sponsor NCDXF. Another exotic visitor was Pasi Z21GS who hopefully will soon get on the air. He studies microbiology at the University of Lund, here in Sweden, returning to Zimbabwe early this year.

These avid DXers are not always just collecting new countries. Quite a challenge for us over here is US County Hunting. SM5CAK has only about 100 left to get out of the total of 3,077. He is either on 21,387 kHz or 28,387 daily at 1430 UTC, depending on band conditions. If you read this and are in a very rare county, why not give Lars a call! Two other well known county hunters (see photo) are Rolf SM4BNZ who works primarily on CW (and has only about 100 left to work), and Hans SM6CVX (with 200 to go). Hans works only stationary ones, which is quite a task. He is on the air with Lars when time permits.

If you are planning a trip to Sweden in the fall of 1989 keep in mind that the DX Meeting, in October, will be held in Karlsbord, arranged by Kjell SM6CTQ and other members of SK6WW. 73

Left to right, Lars SM5CAK, Rolf SM4BNZ, and Hans SM6CVX.

DX *Continued from page 79*

system, which can slow the flow of DX information dramatically. A solution to both of these problems is the PacketCluster (PC) software, which is very similar to PCBS but lacks the bulletin board features of mail and bulletins. (Stations can send short messages back and forth, with a TALK feature, but cannot store them in the system.) PC permits several nodes to link up and share DX information. Each node needs the same hardware as a PCBS node, plus an additional Kantronics KPC-2 TNC, and another VHF FM transceiver and antenna. The second VHF packet system connects the nodes together, while the first provides local access to the system. The second system can be on another 2-meter frequency, or on another band. The northern California DX packet spotting system, for example, ties the nodes together on 220 MHz.

As far as individual users are concerned, there is no difference between PCBS and PC, except for the lack of mail functions in PC. When a user enters a DX announcement, the information rapidly spreads throughout the system. It is relayed to each node, and then on to every connected station. The DX data is stored in each node, and users can call up current or historic DX data just as easily as with PCBS. PC also includes all the other aspects of PCBS: MUF, WWV, sunrise/sunset, beam heading features, local names and locations, and so forth.

PCBS versus Voice Repeater

The PCBS (or PC) system offers several advantages over more traditional DX spotting on local voice repeaters. First, the DXer doesn't have to listen to both the HF radio and the VHF repeater monitor at the same time. The DX data from PCBS shows up on a computer screen, and the DXer can concentrate on the DX station, not the 2 meter box.

Second, PCBS eliminates the need for repeats of DX announcements. Gone are the annoying "What's that call again," or "Please repeat the frequency," requests for duplicating the announcement. The data is right on the screen in front of you!

Third, the DXer can get as general or as specific data as he or she wishes: everything, or just a single band, or even a sin- gle country, all organized by the system.

Finally, the DXer doesn't even have to be in the shack to stay current with DX. Users can access the DX data at any time, so no DXer ever needs to miss any announcements during dinner, snack breaks, or other absences from the shack. Just type SHOW/DX to see what you missed while you were out of the shack.

There is one more benefit of the PCBS system: no rag-chewers can monopolize the repeater and prevent DX announcements, as happens frequently with voice DX repeaters.

PCBS and PC come complete with extensive and detailed help files, so that users can receive more information on any feature immediately. Software documentation is also very good, and the system operator has dozens of control and status commands to modify and monitor the system. Good DX!

Number 36 on your Feedback Card

PROPAGATION

by Jim Gray W1XU

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Daily Report for February

Daily conditions for February will be generally good, or fair to good, as shown on the calendar below. The only poor days will come along at the end of the month. However, be alert for sudden onsets of solar activity, such as flares, which can happen any time, followed by short periods of poor conditions.

We expect the sun to be fairly quiet during February, and the earth's magnetic field will also be reasonably quiet to unsettled for most of the month, except toward the end, when geomagnetic unsettled to active conditions may exist for several days.

February will exhibit the usual winter DX conditions, with fairly early band closings on the 10 and 12 meter bands as darkness falls. For a short while after dark, 15 meters will stay open, and 20 meters will be open until well after local darkness. As far as band openings in the morning, you can expect 20 meters to open first, followed by 15, 12, and 10 meters as the sun comes up and ionization extends to the higher and higher layers of the ionosphere. February is a prelude to March, which should be the best month for HF band DX since Cycle 21.

It's All Relative

As usual, the equinoxes (March and September) have better DX conditions than the solstices (December and June), while the in-between months show poorer propagation conditions. It's important to note, however, that all such things are relative, and that the worst conditions for 1989 will be far better than the best conditions just a few years ago.

Expect excellent late afternoon and early morning conditions on 40, 80, and 160 meters, to the far reaches of the globe—and best of all—these conditions will last most of the night, until midnight or after, and begin again just before dawn. Static levels will probably cause difficulties as major storm systems move across the country, particularly in the southern US and south of the equator, but these will only be temporary. Low-band HF DX will be better than ever.

Openings will occur frequently on 6 meters, and occasionally on 2 meters in February. Keep your ears open, and your radio tuned to WWV at 18 minutes after the hour for solar-terrestrial reports.

One last comment. As most of us who have been active on the HF bands know, the 10 and 12 meter bands have been outstanding for DX propagation for many months. . .AND IT WILL GET BETTER!

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20	-	-	-	-	20	20	-	-	-	15
ARGENTINA	20	40	40	40	-	-	20	15	15	10	10	15
AUSTRALIA	15	20	20	-	40	40	40	-	-	20	20	15
CANAL ZONE	20	20	20	20	20	20	20	15	10	10	15	15
ENGLAND	40	40	40*	40*	-	20	15	10	15	20	20	-
HAWAII	15	20	-	-	-	-	20	20	20	10	10	15
INDIA	-	-	-	-	-	-	20	20	-	-	-	-
JAPAN	15	20	-	-	-	-	20	20	-	-	-	15
MEXICO	20	20	20	20	20	20	20	15	10	10	15	15
PHILIPPINES	-	-	-	-	-	-	20	20	-	-	-	-
PUERTO RICO	20	20	20	20	20	20	20	15	10	10	15	15
SOUTH AFRICA	20	40*	-	-	-	-	20	10	10	10	15	20
U. S. S. R.	-	-	-	-	-	-	20	15	20	20	-	-
WEST COAST	15/20	20/40	80	160	160	160	-	-	-	10	10	15

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	-	-	-	-	-	-	20	-	-	-	15
ARGENTINA	20	20	20	40	40	-	20	20	15	10	15	15
AUSTRALIA	15	20	20	-	-	-	40	-	-	-	15	10
CANAL ZONE	15	20	40	40*	40*	-	20	15	10	10	10	15
ENGLAND	40	40	80	-	-	-	-	20	15	15	20	40
HAWAII	15	20	-	40	40	40*	40*	20	20	15	10	15
INDIA	-	-	-	-	-	-	-	20	-	-	-	-
JAPAN	15	-	-	-	-	-	-	20	-	-	-	15
MEXICO	15	20	40	40*	40*	-	20	15	10	10	10	15
PHILIPPINES	15	20	-	-	-	-	-	20	-	-	-	15
PUERTO RICO	15	20	40	40*	40*	-	20	15	10	10	10	15
SOUTH AFRICA	20	40	-	-	-	-	-	15	10	10	15	20
U. S. S. R.	-	-	-	-	-	-	-	20	15	20	-	-

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15	20	-	-	-	40	40	40	-	-	20
ARGENTINA	15	20	-	40	40	-	-	20	-	10	10	15
AUSTRALIA	10	15	20	20	-	-	40*	40*	20	20	15	15
CANAL ZONE	15	20	20	-	-	-	-	20	15	10	10	10
ENGLAND	20	40	40	-	-	-	-	-	15	15	20	20
HAWAII	10	15	20	40	40	40	-	20	20	15	15	10
INDIA	-	15	20	-	-	-	-	-	20	-	-	-
JAPAN	10	15	20	-	-	-	40	40	40	-	-	20
MEXICO	15	20	20	-	-	-	-	20	15	10	10	10
PHILIPPINES	10	15/20	15/20	-	-	40	40	40	-	20	-	20
PUERTO RICO	15	20	20	-	-	-	40	40	40	-	-	20
SOUTH AFRICA	20	20	-	-	-	-	-	-	15	10	15	15
U. S. S. R.	-	-	-	-	-	-	-	-	20	20	-	-
EAST COAST	15/20	20/40	80	160	160	160	-	-	-	10	10	15

FEBRUARY

SUN	MON	TUE	WED	THU	FRI	SAT
			1 G	2 F–G	3 F–G	4 G
5 F–G	6 F–G	7 G	8 G–F	9 G	10 G	11 G
12 G–F	13 F	14 F–G	15 G	16 G	17 G	18 F
19 F–P	20 F	21 F–G	22 G	23 G	24 G	25 G
26 G–F	27 F–P	28 P				

Forecast With Your PC

Jack Baldwin VE7RG sent me a sample program called CQFCST, which runs on the PC and Radio Shack TRS-80 Model III. He designed this program to help you forecast propagation conditions. CQFCST is a simple-minded program that rearranges K3ASK's and N4XX's forecasts by hours of the day.

Jack also has other programs for the PC and the Model III. One is MUF SCAN, that adapts MINIMUF to scan selected countries or zones, and prints out MUF for preselected hours of the day. CQINFO and CQINFO PC are menu-driven.

Jack has two mailing addresses depending upon the time of year. They are: Lakeshore Rd, Box 598, Kelowna, BC, Canada V1Y-7P2 and 2423 West Tucana St., Tucson, AZ 85745.

73 AMATEUR RADIO®

International Edition

MARCH 1989
ISSUE #342
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Contract: Reading this binds all you electronikers out there in Hamdom to perform the following: 1) Send for our Writer's Guide. 2) Following the instructions therein, apply at least one of your brainchilds to film, paper, and/or diskette. 3) Send it to us in article form for everyone to benefit. No cavilling about how you can't write—everyone can! You'll feel better, and you even get paid.

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73 AMATEUR RADIO®

MARCH 1989 — Issue # 342

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FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

Cover: Heath's new pico-sized TNC—the HK-21
Cover by Deborah Smith
Photography by Suzanne Torsheya

Number 1 on your Feedback card

Welcome, Newcomers!

AMATEUR RADIO DEMYSTIFIED

Welcome to Amateur Radio! Since you're reading this, chances are you've just gotten your amateur license, or are seriously thinking about it.

Like any technical hobby, however, ours is full of techspeak, acronyms, and jargon which can really put off a newcomer. Before I got my "ticket" (Amateur Radio license), I had learned some Morse code. When I tuned on an amateur band on my old Philco radio for nice slow code, however, and copied it, less than one-tenth of it was comprehensible! I knew I wasn't dyslexic, discounted Alzheimer's disease because of age (18), and was told by a native that it wasn't Czech. I resigned myself to the fact that Amateur Radio had its own language and I had to learn it.

Fortunately, there were fellow hams around me who wouldn't let me believe that it was hard, and, after a short time, I was having too much fun to notice. A week after getting my ticket, I made my first international contact in Morse code, with a schoolteacher south of Sao Paolo, Brazil. Contacts with Argentina, Finland, Japan, and Australia ensued, and ham jargon and acronyms showed themselves to be the link between people with no other common language, a kind of radio Esperanto. These once off-putting words and symbols became bonding ones; the system which at first restricted me became a liberating one.

You will hopefully have the company of enthusiastic hams like I did to ease your entry into the hobby. Meanwhile, use the following format as a key into our fascinating world.

Anatomy of a Contact

Most ham contacts follow a standardized format, and there are good reasons for it. Mike fright—not knowing what to say—is a common problem. Many new hams besides you, and not just a few veterans, suffer from it. This isn't surprising when you consider that you're meeting someone for the first time and are still unfamiliar with the equipment, and many of us are naturally shy. It really helps to be able to start off with a protocol which soon becomes automatic. This lets you think about what you're going to say next while tuning your antenna, making final tuning adjustments on your equipment, etc.

To Call

First tune to a clear frequency, making sure that it is in within your license class restrictions. Then, to be sure, call "Is this frequency in use from (your callsign)?", or send "QRL?" Allow 5-10 seconds for a response. Repeat this procedure. If there's no response, call or send the letters "CQ" ("seek you") 6–8 times followed by your callsign, twice. If you're on voice, and conditions are poor, give your callsign phonetically, e.g. "this is 'November-Sierra-One-Bravo'" for NS1B. There are several common phonetics for each letter which you will soon get to know.

Joe Ham will respond by first giving your callsign several times, followed by his callsign. If conditions are poor, he may then say "Do you copy?", or send "QSL?", and wait for you to respond with "I copy," or "QSL." If conditions are better, Joe will probably just continue with a little about himself after responding to your call.

A Little About Joe

We have a tendency to forget to give details about ourself which we consider boring because we repeat them with each new contact. We need to remind ourselves that these details helps the other person identify with us. To keep ourselves in line, we continue to follow a format.

Joe goes on by giving his name, prefaced in CW (Morse code) by "NAME IS..." He then says/sends "QTH is..." followed by his location.

At this point, he will likely tell/send you your signal report. Code reports in CW have three parameters—"Readability, Strength, and Tone"—and are prefaced by "UR RST IS..." In practice nowadays on CW, only the first two characters ("Readability" and "Strength") vary much, since most rigs produce an excellent CW tone. "9" is often shortened to "N", e.g. an RST of "599" is sent "5NN." Voice contact reports are two characters, "Readability" and "Strength." It is often given with an "and" in between; e.g. "5 and 9."

After this, Joe then says "How Copy?", or sends "QSL?" and you take up the mike/key and repeat exactly his transmission format.

After this, it's your choice what to talk about. Many a ham's next step is to describe his station (My rig is..., my antenna is thus and so and is up "X" number of feet, etc.). If you're familiar with Joe's QTH, you can talk about it; if you're not familiar with it, you can still talk about it. Tell'em about your other hobbies, and ask him about his. Ditto for work, family, books read, movies seen, places visited, etc. The list of topics is endless. After the contact, you'll wonder why you ever had mike fright!

Finishing the Contact

A good wrap-up puts a nice cap on a contact. A procedure to follow helps keep the contact from ending too abruptly or dragging out.

The hardest part for most is being the first to say you have to QRT (end the contact). Once that hump is hurdled, you turn the mike to him. He thanks you for the contact and turns it back to you. You then thank Joe for an excellent contact, say "73"(some prefer "73s"), and tell him you "will QSL" (send a card of acknowledgment), and will look for his. You then say "Over to you for your final (words), Joe." He will return and say "Thanks again and 73s. This is (his callsign), clear." You finish your transmission by saying "This is (your callsign), clear."

Remember, these patterns aren't cast in stone—they're meant only to get you started! Good luck! 73 ...de NS1B

"Q" SIGNALS

The language of Amateur Radio is riddled with strange three-letter words beginning with "Q"—you may have noticed that four of our monthly departments are titled with'em.

They first came into being in the Morse code-only days as a way to reduce common questions and statements to a short code and so make communications more efficient. "Q" was likely chosen as the first letter because it's the least common letter in the alphabet, and in normal use is almost always followed by "U"—if "Q" was followed by anything else, it was a sure bet that it was a code.

The "Q"-signal system's *practical* use is more and more dated now with the plethora of highly reliable modes, but it remains rooted in a ham's vocabulary. "Q" signals can be either questions or statements. Here are the most common ones, followed by an example:

QRL—"Are you busy? I am busy." Send this to see if a frequency is clear.
QRM—"Is my transmission interfered with? Your transmission is being interfered with." Often said "Q-R-Mary" to distinguish it from QRN.
QRN—"Are you troubled by static? I am being troubled by static." Often said "O-R-Nancy."
QRP—"Shall I decrease power? Decrease power." There are some hams devoted to elegance of low-power operation. Mike Bryce WB8VGE devotes his QRP column to these enthusiasts.
QSB—"Are my signals fading?" "My signals are fading." Often said "Q-S-Baker." "There's a lot of OSB on the band."
QSL—"Do you copy me, do you acknowledge?" "I copy, I acknowledge." Hams exchange QSL cards to verify their contacts with each other. See "QSL of the Month" next to the Never Say Die column for colorful and imaginative examples of these.
QSO—Conversation. "Thanks for the QSO, old man."
QSY—"Shall I change frequency?" "Change frequency." "Let's QSY to another frequency."
QTH—Location. "My QTH is Peterborough, NH."
QRX—"When will you call me again?" "I will call you at (hours) on (frequency)." Our QRX column is devoted to Amateur Radio news.
QRT—"Shall I stop sending?" "Stop sending." "Dinner's on the table, I must QRT."

JUST PLAIN JARGON

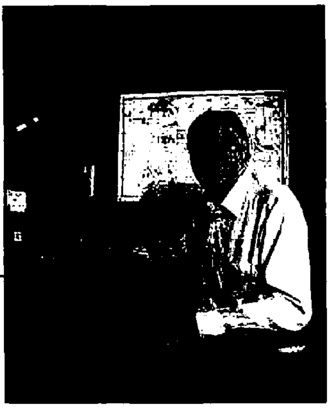
What's a language without fun words and endearments? Following is a list of a few of ours. (Again, most date back to the CW-only days.)

DX-Long Distance—What is considered "long-distance" varies according to what band you are operating on, and at what power level.
OM - "Old Man."—Man of any age.
YL - "Young Lady."—Unmarried woman of any age.
XYL - "Ex Young Lady."—Wife. The "Ex" doesn't imply that she instantly ages upon marriage, just that she is no longer unmarried!
Harmonics—Children of the OM and the XYL
88 (variant: 88s)—Hugs and kisses.
73 (variant: 73s)—The very best to you! Enjoy our magazine!

Number 2 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



220 Is NOT Dead!

The imminent removal of the bottom two megahertz of the 220 band to make room for United Parcel doesn't exactly put the band out of commission. The fact is this won't seriously affect most 220 operations.

I bring this up because the ham dealers tell me that the sales of 220 gear have virtually stopped, apparently in a panic over-reaction by hams who have heard that the FCC is taking away the 220 band, but haven't bothered to read the details. Frankly, I can't think of a much better way to make sure the FCC starts thinking we don't need the 3 MHz we have left. We're still in a use-it-or-lose-it world, so if we stop using 220, why shouldn't we lose it?

Please pass the word to the panic-stricken that 220 is not lost, only the relatively unused end is going away. That won't bother most repeaters. Sure, we're going to have to make some room for a handful of weak-signal fanatics—probably up between the repeater inputs and outputs. For most 220 ops there will be little or no noticeable change.

One of the reasons the FCC went after 220 was the general perception that the band is little used. This isn't quite true, but most of the groups using 220 have been so secretive about their work that little has appeared in the ham magazines. This has, in turn, kept interest in the band down and given most hams (and the FCC) the impression that 220 is almost completely unused . . . a real wasteland.

In amateur radio, as in academia, it's publish or perish. If you do anything unusual on 220 you'd better take the time to write about it to a ham magazine, or, like the falling of a tree in the forest when there is no one there to hear it, questions will arise about whether anything has actually happened.

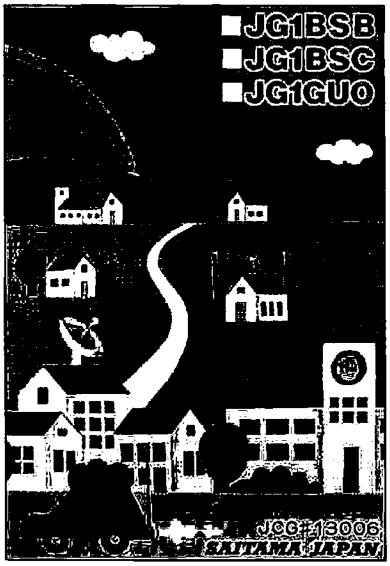
If your club doesn't have a PR person whose job it is to make sure that the world knows about the club's activities, you're part of the problem, not the solution. A club PR person should let the local papers, TV, and radio know about any club events like Field Day, contests, hamfests, special speakers.

If the club has a 220 repeater open for Novices, has the word been spread? I'd love to have you let *73* know about it. And if you have any special features, like a cross-band function so they can work some DX on 10 meters via 220, that's news.

I've been asking for club photos for several years. I can't remember the last time a club got together for a group photo and sent it in. The Japanese ham magazines run up to a hundred pages a month of club photos. This helps the clubs and helps generate more interest in amateur radio.

If this conspiracy of secrecy about amateur radio continues, we're going to have a harder and harder time attracting new hams. Sure, the QRM on 20 meters will eventually go down. Well, the QRM from hams will go down, but you know as well as I that the QRM from foreign government and commercial stations will quickly fill in any vacuum we leave.

So let's get busy and make sure that what little we're doing on 220 is known. Get some articles into *73* on anything unusual you're doing. Make sure your repeaters are listed. Get some pictures of 220 groups into *73*. 220 will be a lot more real if it isn't left as a phantom band.



QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, 70 Rte. 202 N., Peterborough NH 03458, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

NIAC Is Growing

NIAC, the nonprofit National Industry Advisory Committee, now has 17 paid industry-supporting firms and groups! NIAC's purpose is to provide an interfacing group between amateur radio and the FCC. Membership is $100, that goes entirely for an action newsletter and FCC meeting expenses (not including any expenses for participants).

The main goal for NIAC is to promote the growth of amateur radio—for the good of the hobby and for our country.

Continued on page 60

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QRX . . .

EDITED BY BRYAN HASTINGS NS1B

U3MIR Now On The Air!

Cosmonauts **Vladimir Titov U1MIR** and **Musa Manarov U2MIR** returned safely to earth on 21 December at 2157 UTC, ending their year-long stay in outer space on *Mir*. Vladimir and Musa made amateur radio history as the first to operate a ham station station aboard an orbiting space station. They made hundreds of contacts with terrestrial amateur stations.

On 19 December, during *Mir* orbit 16305, Musa said farewell to all hams. The 2 meter FM station remained aboard, and is now operated by Dr. Valeri Polyakov, using the call U3MIR. It appears, however, that Valeri speaks only Russian. At this time, AMSAT-NA has no information about the operating times of U3MIR.

Hams worldwide thank Musa and Vladimir for this first in amateur radio. We thank Musa especially for his initiative and determination in getting a station aboard *Mir* and getting licensed—all done while in space.

Armenia

"73 International" Soviet correspondent, Gennady "Gena" Kolmakov **UA9MA**, has been very actively involved in the Armenian relief effort. Gena arrived at Leninakan, Soviet Armenia on 11 December to provide communications support for the relief effort. Ed NT2X, managed to contact him at that location on the 19th, though the path was very noisy and Gena was operating only 100 Watts into a dipole. Though their contact was sketchy, Gena managed to transmit the brief statement: "Ed, I saw things you could not imagine." Look for a full report from Gena in an upcoming "73 International."

Commendations also go to Ed who has handled hundreds of pieces of H&W traffic between Armenia (via UG7GWO) and the US.

Cranston

US Senator Alan Cranston distributed a letter to hams in California that suggests the FCC might reverse its decision to reallocate the 220 to 222 MHz band to land mobile use. In his November 29th message, Cranston says he contacted the commission and learned that the FCC is reconsidering the reallocation action. This comes as no surprise since the FCC has on file almost *700* petitions from hams who want the reallocation cancelled.

Youngest Extra?

Sandi Saunders is yet *more* proof that neither code nor theory need keep you away from getting your ticket. Sandi got her Novice ticket (KC4AJO) at age eight in May 1987, and has since steadily marched her way up to Extra Class. She passed the theory exam for the highest license at the July '88 Atlanta hamfest, and the code section several months later. Age when she became Extra-Class: 10 years, 3 months. Sandi's the harmonic of Dean AA4XL and Ruth N4NVX.

All-County First?

Ken Wosika KB7QO of Las Vegas may well be the first ham to have transmitted mobile from all counties in the US. How many did you catch him in?

Stay In Band!

A reminder to all the 10 meter enthusiasts that the FCC does not permit phone operation below 28.3 MHz. IARU band plans in all regions protect beacons at 28.2–28.3 MHz from regular two-way operations, and all amateurs should avoid operating phone below 28.3 MHz, even outside of the US where such operation might be permitted by the licensing authority (e.g., Canada).

Digital Radio

What comes after AM and FM radio? **Digital Modulation, or DM.** In the United States, National Public Radio (NPR) called on the FCC to allocate a new broadcast band for DM. NPR says: "It does not seem likely that advanced radio systems incorporating digital techniques will be fully exploited using existing AM or FM bandwidths. . . therefore, new spectrum is almost certainly required."

DM offers more more faithful conveyance of digital signals, such as those that come from compact disc players. The problem, though, is that digital reception is either 100% perfect or non-existent. As with current AM or FM, there can be "holes" or "shadows" in coverage areas, under bridges, and behind tall buildings. Multipath, in which different phases of the same signal arrive at a receiver, can also be a problem. Richard Lambley of *Electronic and Wireless World* magazine offers a solution to this.

The new service would be wideband, with 16 stereo channels scattered over 4 MHz of spectrum space. This band would be cut into some 450 narrow carrier frequencies. The 16 digital channels would be scattered across all these frequencies, using a system called "Orthogonal Frequency Division Multiplexing with Convolutional Coding." This should eliminate fading and "radio shadows."

If part of the signal disappears, it can be filled in from the carriers on other frequencies, which are likely affected differently. Finding a free allocation in the already crowded radio bands may be the biggest problem. Engineers would like to see the digital system assigned to frequencies somewhere between 500 and 2000 MHz, an extremely popular part of the spectrum.

17 Meters

A group of US hams with experimental licenses now transmit on 17 meters. They hold regular skeds on Saturdays and Sundays at 1900 UTC on 18.111,

Continued on page 14

$$ HOME-BREW IV $$

73 Magazine again invites all home-brewers to turn their hot solder into cold cash and prizes, and to get their name in print to boot. All projects have a chance to appear in the magazine, and we will handsomely reward the authors of the best of these.

Now for the bounty. Ramsey Electronics sweetened the pot from their line of frequency counters. First prize is $300, a 10-year subscription to *73*, and a CT-125 1.25 GHz frequency counter. Second prize is $150, a two-year sub, and a CT-90 600 MHz frequency counter. Third prize is $75, a two-year sub, and a CT-70 525 MHz frequency counter. All this is in addition to the payment every author receives for publishing in *73*.

Contest Rules

1. Entries must be received by 1 April 1989.
2. To enter, write an article describing your best home-brew construction project and submit it to *73*. If you've never written for *73*, send an SASE for a copy of our Writer's Guide, or download it from CompuServe (Hamnet forum, Library Ø., filename "73WRIT"). *Be sure to state on the submission that it is for the Home-brew IV contest.*
3. Here's the real challenge: The total cost of your project must be under $73, even if all the parts were bought new. Be sure to include a detailed parts list with prices and sources.
4. Our technical staff will evaluate each project on the basis of originality, usefulness, reproducibility, economy of design, and clarity of presentation. The decision of the judges is final.
5. All projects must be original. That is, they must not be published elsewhere. There is no limit to the number of projects you may enter.
6. All purchased articles become the property of *73 Magazine*.
8. Mail your entries to: *73 Magazine*
WGE Center
70 Rte. 202 N
Peterborough, NH 03458-1194
Attn: Home-Brew IV

QRX . . .

Continued from page 11

in addition to impromptu midweek skeds. Recently the skeds were expanded to additional tests at 1600 UTC. This group includes Bill Orr W6SAI (KM2XDW) in California, Stu Cowan W2LX (KM2XDU) in New Hampshire, Fred N0CAO (KA2XAE) in Missouri, Bob Stankus WS4I (KB2XCQ) in Virginia, and Phil Galasso K2PG (KA2XUK) in New Jersey. [*On 17 meters the experimental callsigns are used.–Ed.*] FCC regulations permit two-way contacts only between experimental stations, but the group, involved in a propagation study of this band, welcomes signal reports from any and all listeners. They have already collected reports from various DX locations and from across the US. The mailing address for QSN reports is: Fred A. Sontag, P.E., Lake Farm, RT 1 Box 86, Tebetts, MO 65080.

A little hot-air balloon mobile, anyone? These low-fliers were at last year's Dayton show

Emergency Reminder

Health and Welfare traffic does *not* carry emergency priority. Many operators didn't realize this during emergency communications in the aftermath of Hurricane Gilbert. During these operations, 20 meter emergency nets were seriously hindered from passing priority messages, such as relief supply information, because of H&W traffic.

The main difference between H&W and emergency priority is that the latter concerns the whole relief effort, whereas the former concerns an individual or small group of individuals. On-air clarifications about this were difficult at best, though, because by the time net control finished explaining, a new raft of H&W stations rolled in on frequency.

Ham Radio-Based Curriculum

Through the efforts of the Council for the Advancement of Amateur Radio in the NYC schools, a curriculum bulletin entitled "Amateur Radio in the New York City Schools" is nearly complete, according to Martin Smith KA2NRR, President of the Council, who heads the team. Team members included Joe Fairclough WB2JKJ, Jeff Feigenbaum KA2KSW, Al Misunas WB2RLQ, Rich Wolfert WB2EYI, and Len Zuckerman KB2HK. The New York City Board of Education's office of Media and Telecommunications, under the supervision of project coordinator Jerry Eisenberg K2CFG, is now reviewing and editing the bulletin.

The curriculum guide, funded by a $7,000 grant, will have a total of 50 pages of sample elementary and secondary level lessons in different subjects, strategies for organizing school activities, a bibliography of useful materials, and a recent source listing of radio clubs and speakers available in the New York City area. One thousand copies will appear in late fall for distribution. The Council also plans an in-service course for teachers for the spring school term.

Out Of The Fog-M

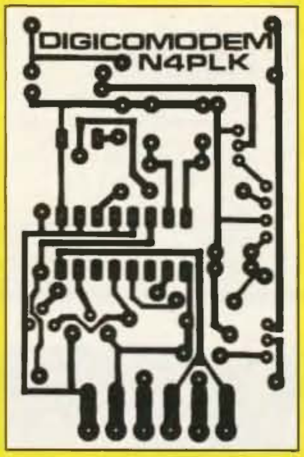
The US Army's use of the 70 cm band in Northern Alabama for testing a new missile system concluded 16 December, according to Army spokesman Bob Hubbard. Amateurs using the 420–450 MHz band observed weekday quiet hours since October to facilitate this experiment, which involved airborne sensors for testing FOG-M, a fiber optic guided missile. Amateurs share the 70 cm band in Northern Alabama with the military. Voice repeaters and packet trunks in Huntsville were among the amateur systems affected during the quiet hours. The Muscle Shoals Amateur Radio Club also took its packet system off the air. Hubbard says he knows of no cases of interference during the testing.

Tompkins is SK

One of the most noted writers in the world of amateur radio, Walker A. Tompkins K6ATX, passed away on Thanksgiving Day, in Santa Barbara, California. Tompkins was best known for his series of Tommy Rockford Ham Radio Adventure Books.

Inflation

All TCM 3105 modem home-brewers take note. The printed circuit board foil diagram shown on page 43 of last month's issue is 115% of actual size. Please use the actual-size foil diagram below. We apologize for the inconvenience.



Whose Idea Was It, Anyway?

Fred Maia W5YI tendered his resignation as a director of the newly formed National Amateur Radio Association. Maia cited the reason for this as the widespread misconception that the drive for a code-free entry level license originated with NARA and not with him. The Dallas publisher says that the no-code initiative is his alone, and that NARA is only one of a broad base of supporters made up of industry, and concerned amateurs and non-amateurs.

NARA is currently headed by Don Stoner W6TNS.

Thanx!

To all who contributed news items to this month's QRX column. They are: *Westlink*, *Federal Communications Technews*, *Sweden Calling DXers*, *BNT Bulletin*, *The North Florida ARS Balanced Modulator*, Fred Sontag N0CAO, ARRL Hudson Division, David Black KB4KCH, and AMSAT-NA News Service. Keep your news items and photos rolling in!

Control Head for the TS-440S

Convenient mobile HF operation.

by Wesley E. Rader WB0UVN

Do you have a Kenwood TS-440S with the VS-1 voice synthesizer, or are thinking of buying one? Do you have an interest in mobile HF? If you answered "Yes" to both questions, this article is for you! It shows how to build a very small control head for the front seat of your car (Photo A) which allows you to remote your TS-440S, such as to your trunk!

Materials

A shielded 12-conductor cable gives you access to controls and information on the TS-440S. The control box is a 1⅛" x 2⅛" x 3¼" plastic box from Radio Shack. It contains controls for on-off/volume, frequency up-down control, PTT, and voice synthesized frequency announcement; and a 2" speaker. This covers everything you need to operate the TS-440S mobile!

Photo A. A control head for the front seat of your car to access your Kenwood TS-440S in the trunk.

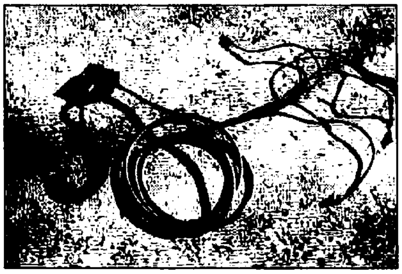


Photo B. The control box/cable assembly.

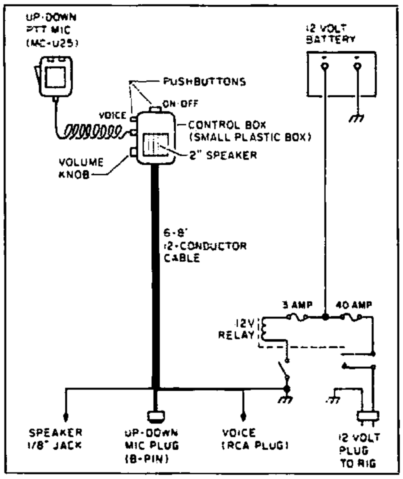


Figure 1. Wiring for the control box and TS-440S mobile installation. A 12 volt relay supplies 12 volts, 20 amps to the TS-440S. Fuses protect the rig.

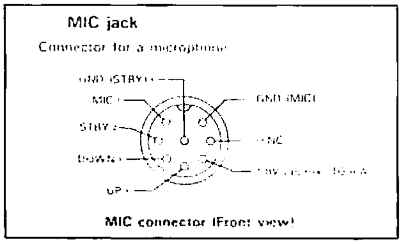


Figure 2. Mike pin configuraton for the TS-440S.

Construction

There is only one mod needed on the rig, besides installing the VS-1 voice synthesizer. This mod allows you to activate the voice synthesized frequency read-out from the control box. You first must open up the 440S and find "J54" on the control panel circuit board (X53-1450-00 [B/2]). You will see that a pair of wires go from pins 3 and 4 of "J54" to the voice synthesized frequency read-out control. Attach two new wires to pins 3 and 4 and run these to the ACC-3 RCA jack on the back panel of the rig. This allows an external RCA plug to control the voice module. This is then taken through the cable to the control head. Do not ground the outer part of this plug.

After obtaining the cable and parts, solder the plugs: (1) a 12 volt, 2-prong plug; (2) the 8-pin microphone jack; (3) the voice, RCA male jack; and (4) the ⅛" speaker jack, to the end of the cable that will be in the trunk of the car with the TS-440S (Photo B).

There are many other possible combinations of plugs and switches. Be creative!

Cable Line Routings

The ON-OFF switch on the volume pot turns on a 12 volt relay that supplies 12 volts at 20 amps to the TS-440S. Fuses also protect the rig. (See Figure 1.)

The voice button (RCA jack to ACC-3 circuit board on the rig) activates the frequency read-out.

The up-down microphone jack is an 8-pin jack. (See Figure 2.)

The speaker port is a ⅛" jack.

At the other end of the cable, attach the plastic box and solder in the OFF-ON part of volume pot, the voice button, and the up-down and PTT 8-pin microphone speaker and volume pot.

The arrangement of the controls is up to you.

Operation

How simple can it be? Use the up-down microphone buttons to choose the frequency of the band you preset, or select one of the 100 memory frequencies and modes, or even split frequencies, such as for 10 meter FM repeater work, depending on what your mobile antenna will handle. One touch on the voice button verifies in-band frequency. Push the PTT switch to talk. Simple! Happy HF mobiling! 73

Parts List

Quantity	Description	Part Number
1	6 to 8-foot shielded 12 conductor cable with one internal shielded wire for microphone (if possible, surplus video cable).	
	Control Head	
1	1⅛" x 2⅛" x 3¼" plastic box	RS 270-230
1	8-pin microphone jack (female)	
1	miniature volume control with OFF-ON switch	
1	2" speaker	RS 40-245
1	voice button, momentary on-push	RS 275-1547
	Rig End	
1	⅛" male speaker jack	RS 274-287
1	8-pin microphone jack (male)	
1	RCA male jack	RS 274-384
2	12 volt, 2-prong plugs; 1 male, 1 female	RS 274-202
1	12 volt relay and socket	
1	3 amp fuse and holder	
1	40 amp fusa and holder sufficient wire from 12 volt source to relay and fuses.	

Switching for Older RF Amps

Connect your old amp to your new HF rig.

by Bill Clarke WA4BLC

Several months ago I wrote an article that gave instructions for building a relay switching adapter inside the Heathkit SB-200 linear amplifier so that it could be used with modern solid state transceivers. (See "Modernizing the SB-200," in the August issue of *73*.)

Since then, many readers have asked me if it is possible to adapt that scheme to older amplifiers. The answer is yes, and the instructions follow.

Why the Need?

At most hamfests, and in the ham classified ads, you will find older linear amplifiers at bargain prices. Such examples are Hallicrafters, Bandit, SBE, Swan, and National. Many use the popular 3-500 tube(s), but most are not directly compatible with modern transceivers. These older amplifiers have keying circuits using voltages much higher than the allowable low-current 12-volt DC relays found in today's solid state transceivers. If you attempt to directly key an older amplifier with a new transceiver, you most likely will damage that internal relay (mechanical or solid state). Repair will cost at least fifty dollars.

Building an External Relay

Here's how to build a small external relay interface box that will connect any solid state HF transceiver to an old amplifier. The interface box is built of parts from Radio Shack. Part numbers are given in the Parts List.

The unit not only controls the keying of the amplifier, but includes status lights and a bypass switch as well. You can build it for less than twenty dollars in a single evening. If you have some of the items in your junk box, the project will be even cheaper. If you have 12 volts DC available, you will not need the 12 volt DC adapter. This would save you $10.95.

Construction Details

Open and disassemble the interface unit's plastic case. Mark the positions for the pilot lamps (2) and the switch (1) on the face plate. The lamps should be 1" horizontally from each side, and centered vertically. The switch is centered in both directions. Drill ½" holes for the lamps and a ¼" hole for the switch.

Install the lamps and the switch, being careful not to mar the case front. Hold the terminal strip in the center of the rear panel and mark the positions of the mounting holes. Using a drill of the same diameter as the strip's holes, drill holes into the panel to match those on the strip. Mount the strip with suitable nuts and bolts. An alternate method of attachment is to use epoxy glue or hot glue.

Drill a ½" hole immediately above the terminal strip.

Mount the relay on the inside of the rear panel with epoxy glue or hot glue.

Wire the unit as indicated in the schematic or pictorial diagrams. Pass the wires from the lamps, switch, and relay through the rear panel (½" hole) to the terminal strip and attach them to the upper screws of each terminal. You will use the lower screws for power and radio or amplifier connections.

Testing Instructions

Hook up 12 volts DC to terminals 3 and 4. Terminal 3 is negative and terminal 4 is positive.

Push the switch to the right. The green light should come on, indicating the unit has power. If not, recheck your wiring.

Short terminals 1 and 2 together. You should hear an audible click as the relay closes, and the red light should come on. If not, recheck your wiring.

Using a VOM, or continuity checker, check terminals 5 and 6 for open circuit when only the green light is on; check them for closed circuit when the red light is also on. If not, recheck your wiring.

Using the Interface

Turn your interface box, transceiver, and amplifier off before proceeding.

Connect a pair of wires from terminals 1 and 2 to the control outputs of your transceiver. Refer to your operator's manual for information specific to your rig. The connections will be NO (normally open) and closed when the PTT line or VOX is activated. Terminal 2 of the interface's terminal strip is the circuit ground, if your transceiver uses a grounded/shielded type of plug. In most cases polarity is not a consideration.

Connect a pair of wires from terminals 5 and 6 to the keying inputs (relay control) of your amplifier. Polarity is not a consideration.

Turn your transceiver and amplifier on. After the equipment has warmed to operating temperature, key the transmitter. The amplifier should not key and no lights should be lit on the interface.

Turn the interface on and the green lamp will light, indicating power on. Press the transceiver's PTT (transmit) switch and the red lamp will light, indicating relay closure. At the same time the amplifier will key.

Follow your amplifier's tuning instructions before keying it for more than a couple of seconds at a time.

When you don't wish to use your amplifier, turn the interface off.

Be Considerate

For the sake of the rest of us using the ham bands—please, only use your amplifier when necessary to maintain communications. When you need the extra few dB, though, rest assured you can safely drive your older amp with you newer rig! ■

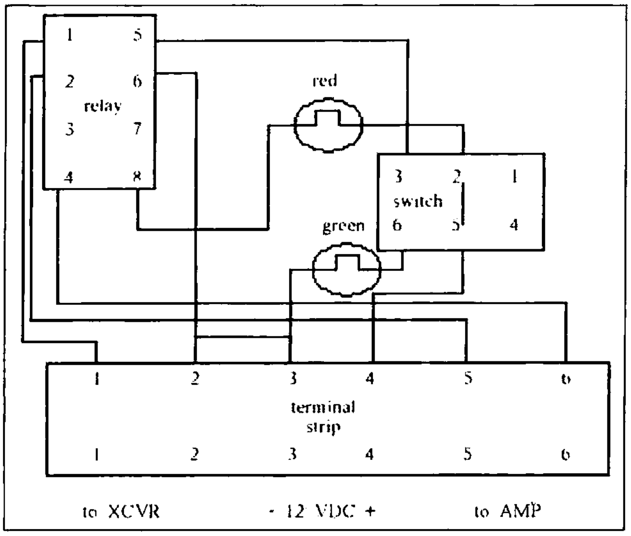


Figure 1. Pictorial diagram of the interface unit.

PARTS LIST

Part#	Part	Price
275-213	relay	$3.99
275-662	switch	$3.19
272-332	red lamps	$1.69
272-337	green lamps	$1.69
274-659	6 position terminal strip	$1.59
270-250	plastic case	$4.99
273-1652	12VDC adapter (optional)	$10.95

73 Review

by A. Leigh Hawkes VE1GA

The ISOTRON 80

80-Meter antenna for cliff-dwellers.

Bilal Company
137 Manchester Dr.
Florissant CO 80816
Price Class: $66

Many radio amateurs live in areas where there is often a lack of space for traditional antenna designs, or where antennas are forbidden by restrictive covenants. With typical ingenuity and inventiveness, many hams have home-brewed clever antenna systems to accommodate these circumstances. However, for those not wishing, or not having the resources, to home-brew a restricted space antenna, there is now a commercial offering from the Bilal Company—the ISOTRON.

Unique HF Antenna

Resembling a slightly oversized bird feeder, the ISOTRON 80 is one of the most unique HF antennas I've encountered in nearly a quarter century of hamming. Manufactured of tempered aluminum, PVC, and cast acrylic, the ISOTRON unit's basic form consists of a fashioned aluminum top and bottom plate, with a coil assembly of approximately 4.5 inches in diameter mounted between them. Included are supporting insulators, mounting brackets, and tuning bars which adjust the antenna to resonance in the required portion of the band.

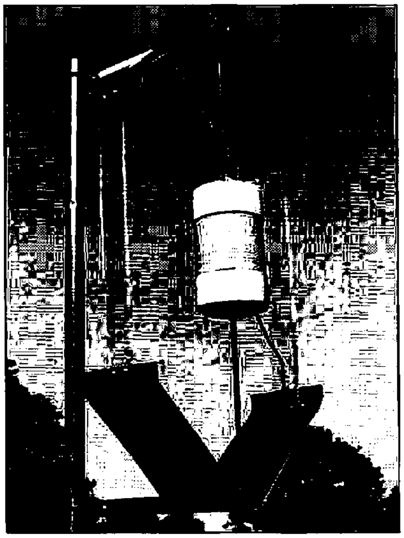
The ISOTRON stands just 35 inches high with a depth of 15 feet (including mounting brackets) and a width of 23 inches. It is rated at 2 kW PEP, produces an omnidirectional pattern, and is coaxially fed through the familiar SO-239 connector. Specified bandwidth is 110 kHz user-adjustable to any portion of the 80/75 meter band.

Assembly

Shipped in kit form, the ISOTRON comes with a full set of assembly and tuning instructions. The step-by-step instructions and several pages of pictorial drawings serve well to answer questions about parts identification and how the pieces fit together. Including time to check each part and read each step twice, I assembled the unit in less than thirty minutes. A word of caution: the aluminum top and bottom plates as well as the capacity hats have very sharp edges and corners. Depending upon the antenna's final location, it may be prudent to smooth off these edges and round off the corners of the capacity hats.

Tuning

A comprehensive set of tuning instructions accompanies the antenna. This is necessary because, as with any shortened or restricted space antenna, tuning tends to be very sharp. Any change in the antenna's environment can have a pronounced effect on tuning. A list of approximate settings is given for operation in various portions of the band.



The Isotron 80 antenna. Ideal for restricted space installation.

You need only an SWR bridge to tune the antenna. The instructions thoroughly describe a method of determining the antenna resonant point by using nothing other than "hand capacity" and the station receiver. You tune it by adjusting the tuning bars attached to either side of the top plate. These bars look like two small arms. Add or delete these bars, and the capacity hats that attach to them, according to the part of the band in which you wish to operate. Rotate the arms from the vertical to the horizontal position to obtain minimum SWR.

Field Test

I conducted tests with the antenna outdoors in a typical city lot. I mounted the ISOTRON on a pole ten feet above ground and used a half-wave inverted vee for comparison measurements. In this configuration, tuning varied somewhat from the approximate measurements given. Bandwidth in which the SWR did not exceed 2:1 was measured at close to 90 kHz. This compares well to the 110 kHz specification, which notes that environmental effects are to be expected. Height above ground and surrounding objects have a very pronounced influence on this antenna. At the test height, this also included rain. During a moderately heavy rainstorm, the ISOTRON, which had previously been operating with an SWR of under 1.5:1, became completely unusable, with the SWR rising to beyond 3:1. A check showed that the antenna coil assembly drain was clear. The problem was thus attributed to ground conductivity changes exaggerated by the low antenna height.

In operation the ISOTRON 80 performed beyond expectations. Received signal levels were generally about two "S Units" below the inverted vee. This had the pleasant effect of lowering several sources of local noise, thereby making it easier to copy the desired signals. I received transmit signal reports from a number of stations across the Atlantic Provinces. All indications are that the ISOTRON was performing similar to what might be expected from a mobile station.

Comments/Observations

When it comes to operating from a restricted space, no two locations are the same and they are not likely to produce the exact same conditions. The ISOTRON's size lends itself well to chimney, fence post, balcony, stairwell, closet, spare room, and attic, etc., mounting configurations. Each location, be it indoors or outdoors, will present its own unique conditions. Interaction with the surrounding environment can produce both positive and negative effects. Expect tuning and performance to vary.

Narrow bandwidth, reduced radiation efficiency, and sharp tuning are tradeoffs you can expect from a restricted space antenna, compared to a half-wave dipole. In return, the ISOTRON allows operation on a band that might otherwise be unavailable to the operator. Yes, this is a compromise. But, for many of us with few alternatives, it's quite acceptable.

The ISOTRON 80 is not a replacement for your full-sized 80 meter antenna, nor is it meant to be. (Unless of course, your full sized antenna has temporarily yielded to the elements. At times like this an ISOTRON in the attic could be a nice backup.) When and where space constraints preclude the use of traditional antennas, the ISOTRON 80 deserves consideration. If mounted outdoors, its unique design and appearance is sure to attract the attention of both family and neighbors. Comments have ranged from curiosity to affection. Its small size and appearance seem to make it at least acceptable to those who do not usually take delight in the beauties of traditional amateur radio antennas.

My special thanks to Carl VE1BQO, who graciously assisted with this review, and to his XYL, who gave the ISOTRON the "XYL Stamp of Approval."

Link Controller for the S-COM 5K Repeater Controller

Repeater linking—cheaply!

by Allan Overcast KF7FW

Would you like to have a repeater of your own, but you can't afford the luxuries of remote programming, selected access, and linking? A new repeater controller has hit the market that skillfully fulfills two of the three requirements: remote programming and selected access. The third luxury, repeater linking, only comes with high-priced repeater controllers, right? Wrong! The S-COM 5K repeater controller, priced at $189, is the perfect piece of equipment to upgrade your repeater's controller. With this low-cost link controller project, you can expand your system into a two-link prioritized controller.

The Heart of the System

The inexpensive S-COM 5K repeater controller is the heart of the system. With it, you can program all functions of the repeater remotely, using either the control receiver or the main repeater receiver as the communications medium. Included in its operations are three logical inputs, three logical outputs, priority control receiver ports, and a PL tone input. You can create macros, which are "small programs." Macros allow you to simplify operation: a couple of keystrokes will execute a sequence of commands. Once you have programmed these simple keystrokes to execute the sequence, you no longer have to remember the longer sequence. This feature also allows you, the control operator, to keep secret sensitive commands. Only you know the macros you've created and what they will do. With all of these features available for such a small price, any repeater organization can afford to upgrade their repeater to a fully automatic microprocessor-based system.

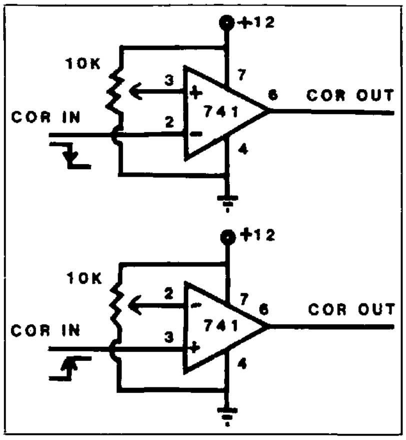


Figure 2. Receiver COR circuit.

Construction of the Link Controller

Keeping to the low current needs of most repeater systems, the link controller is designed completely around CMOS devices. Along with the need for low current was the need for user-friendliness. You can observe all functions of the link controller by adding an optional plug-in LED display board which communicates all major functions.

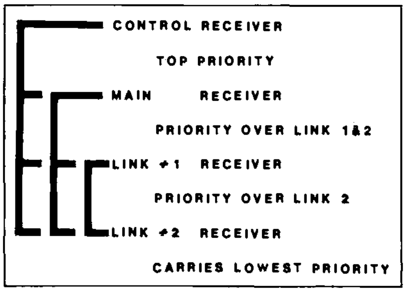


Figure 1. Receiver voting scheme.

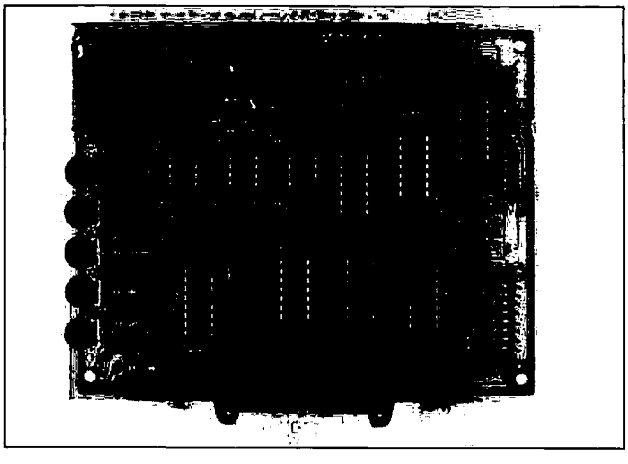


Photo A. The '5K Link Controller.

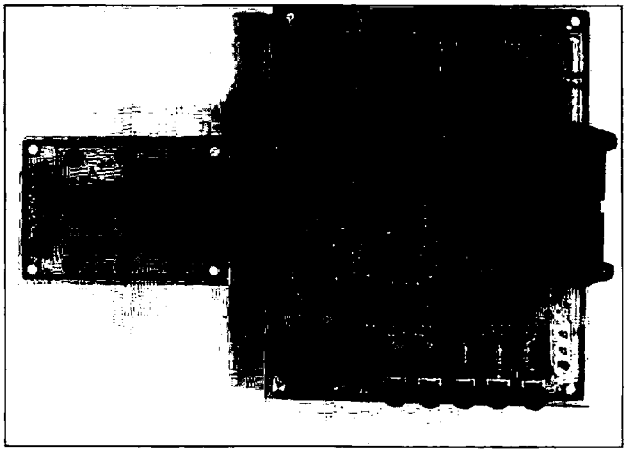


Photo B. The Main Controller Board and the optional LED display panel.

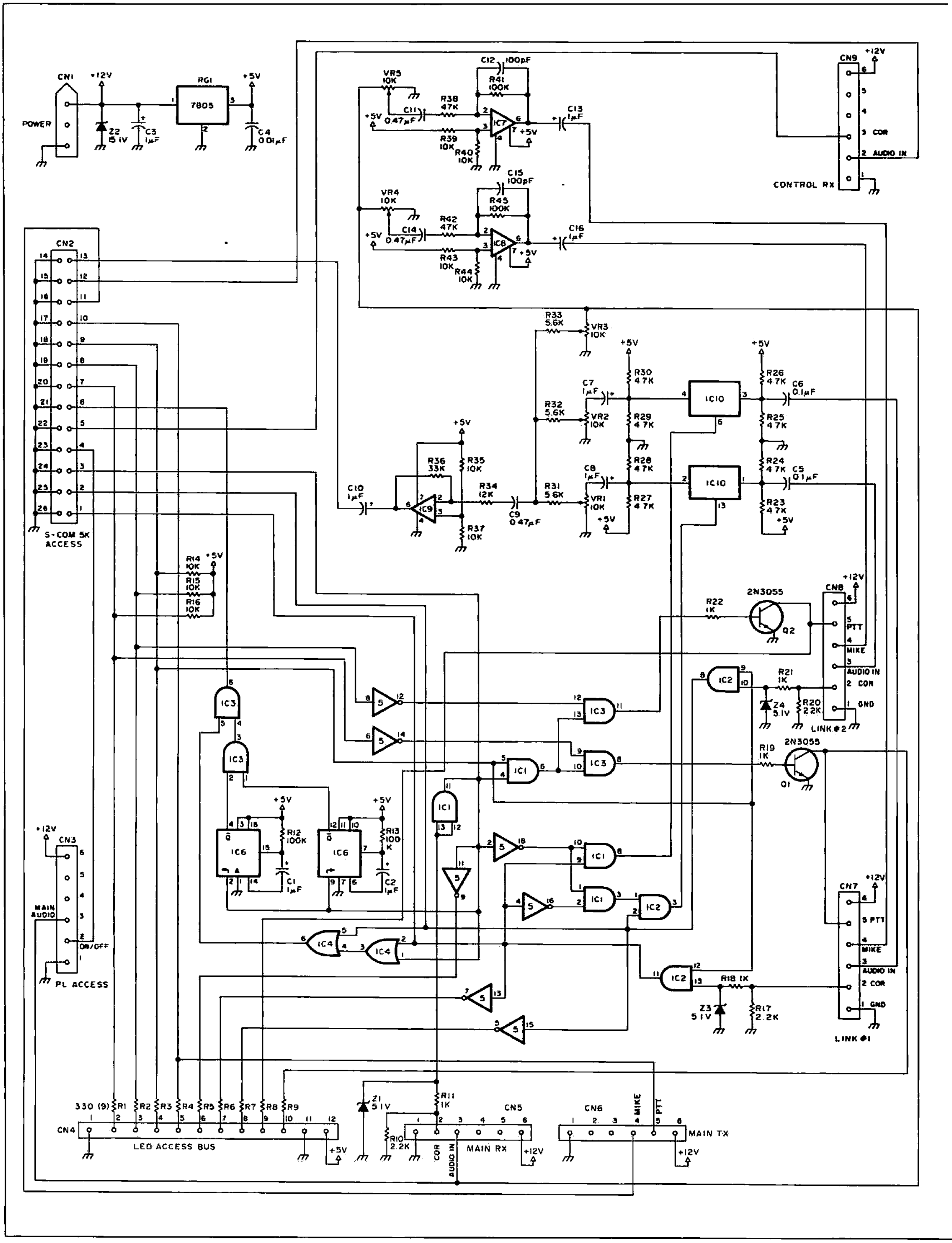
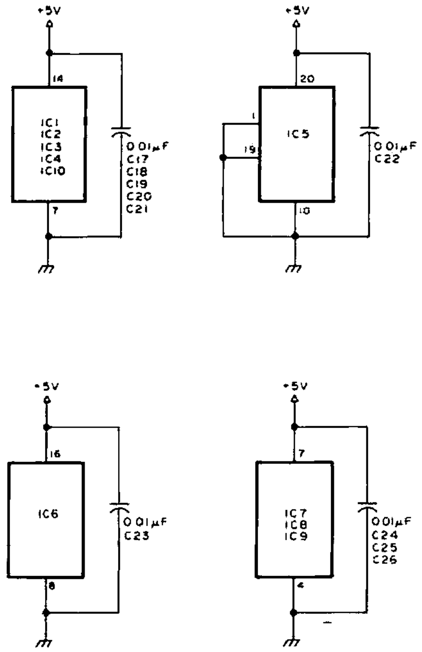
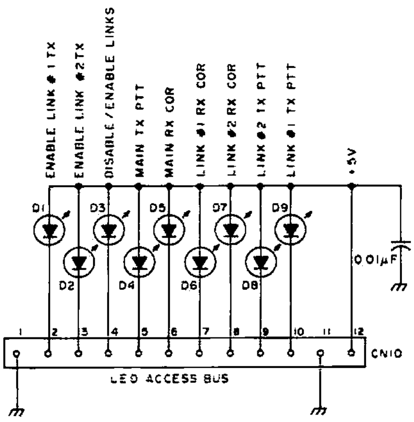


Figure 3. Schematic for the complete board of the 5K link controller.



IC 1, 2, 3 - 74HC08
IC 4 - 74HC32
IC 5 - 74HC240
IC 6 - 74HC123
IC 7, 8, 9 - LM741
IC 10 - 4066

C17-C26 - 0.01µF



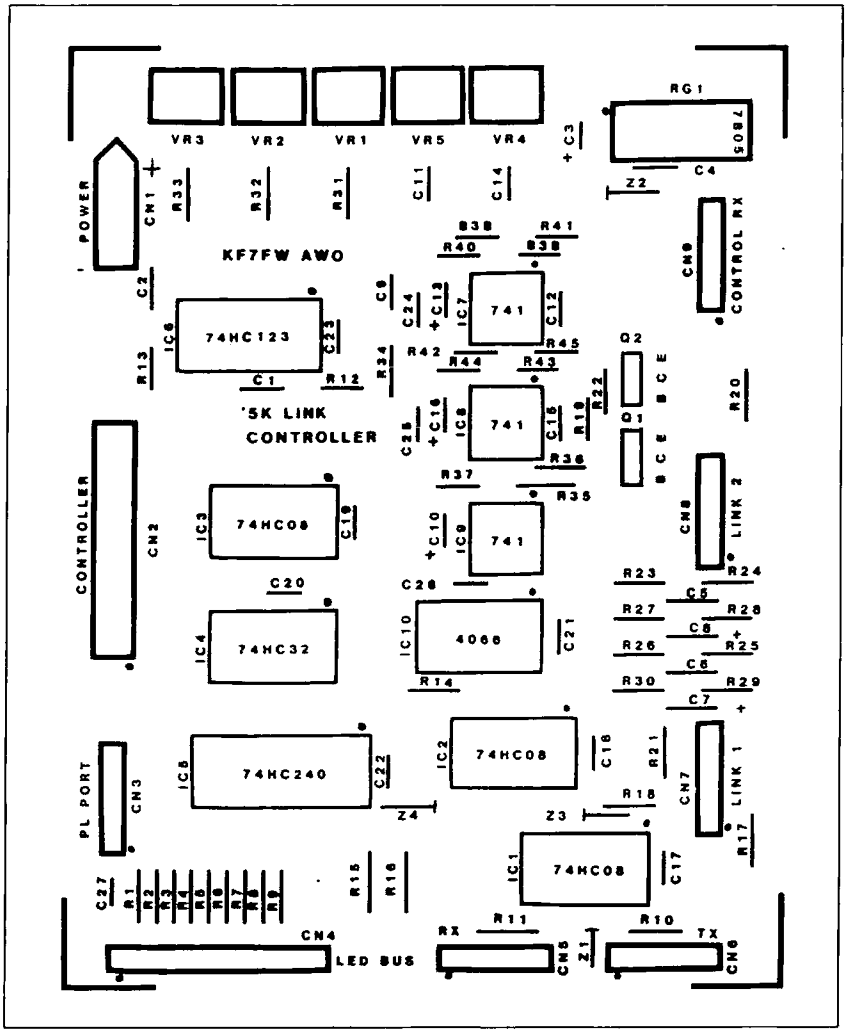


Figure 4. Main board parts layout.

Know Your Priorities

On any repeater system, the control receiver must carry the highest priority (see Figure 1). If this is not observed, the repeater may not be available due to access problems. The control receiver is not processed on the link controller; instead, it is simply passed directly to the main controller. The main receiver is the next priority. People access it to control the links, so either of the links carry less priority than the main receiver.

The two controllable links, of course, are next on the priority list. The links numbers, 1 and 2, pertain to the order of priority. If link 2 is active, and link 1 suddenly becomes active, then link 2's audio is cut off until link 1 becomes inactive. The same activity pertains to link 1 and the main receiver. The priority feature allows the repeater owner to assign the order of important to each item.

Constructing the COR Circuit

On any receiver, there is a voltage that changes when the receiver's squelch opens. This voltage, referred to as the COR (carrier operated relay) signal, tells the link controller when the repeater is active and when it is inactive. The controller's COR voltage needs to be greater than 3.0 volts for the controller to recognize it.

You can construct a simple, effective COR circuit from a single op amp and a variable resistor (see Figure 2). By adjusting the variable resistor to a point different from your receiver's carrier noise source (a voltage that changes when your receiver becomes active), the op-amp will change its output from low to high, indicating an active receiver is present. The link controller's COR input is at 2.2k ohm impedance. Once the signals are in the controller, they are buffered before any processing occurs. The main receiver's COR signal is passed directly to the links ORing section. At this point, all COR signals are passed to the main controller.

The greatest section that the main receiver's COR signal passes through is the time-out reset section. This section will reset the main controller's time-out timer every time the main receiver becomes active and every time it becomes inactive. IC 6, the 74HC123, is used for this purpose.

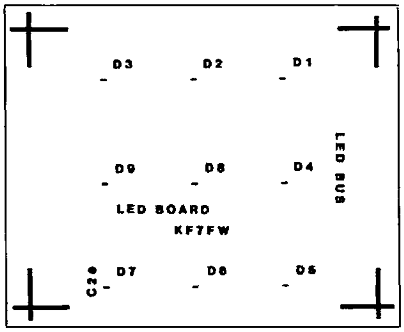


Figure 5. LED board parts layout.

Half of the one-shot multivibrator is programmed to trigger on a low-to-high transition of the main receiver's COR signal, and the other half is programmed to trigger the high-to-low transition. When either of the one shots is triggered, a 100 ms pulse is delivered to the reset circuit of the link controller. This reset circuit is needed because all of the COR signals entering the link controller are ORed together through IC 4.

In correct operation the repeater will time-out if one of the links is on for more than the programmed time-out period. Without the time-out reset circuit, the main receiver could not use the repeater until the links became inactive and reset the time-out timer. With the reset circuit on the controller, every time the main receiver becomes active, it sets the time-out timer to zero. If the repeater is timed out because one of the links was on too long, it is back, ready for use, the moment the main receiver becomes active.

The two link COR signals do not reach the ORing section of the controller before they are processed for their priority. Once they pass the link enable section, IC 2 and IC 3, they now head for IC 4, the COR ORing section. Now their priority is to switch one of the link's audio source to the main controller's audio section. Audio switching is accomplished by IC 10, a 4066 which contains four analog switches. This switch makes or breaks the audio from both links. Link priority only applies to audio; it decides which audio is routed to the main controller. Once audio switching occurs, you can adjust the audio level before it enters the mixing stage of the link controller.

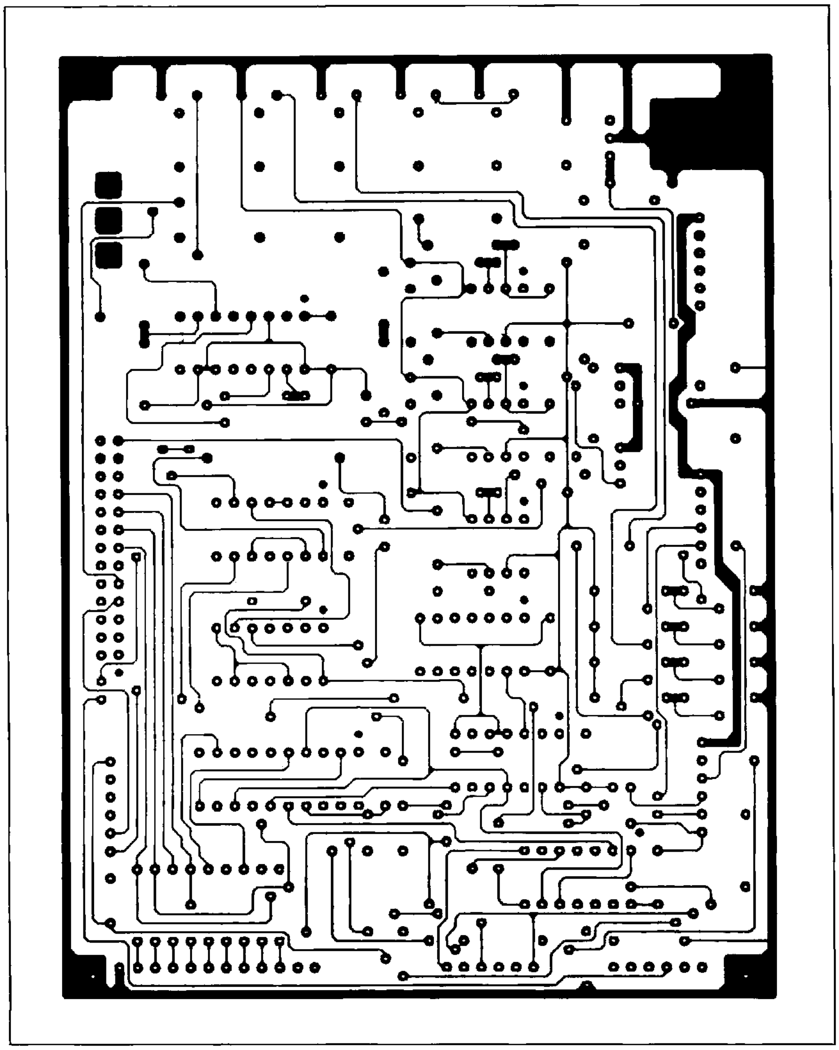


Figure 6a. Top foil layout for the main board..

Time to Transmit

The purpose of a repeater link is to transmit. If your links were always enabled, your repeater would be tying up another repeater, as well as your repeater, on every transmission. The main controller controls the section of the link controller that enables the links to transmit. Three MOSFET switchable lines come from the S-COM 5K controller and are processed by the link controller before they can PTT either of the link transmitters.

The first two lines, Out 1 and Out 2, are inverted by IC 5 and then gated through IC 3. The third line, Out 3, determines if the main receiver's COR signal will reach the link transmit enable section. If Out 3 is enabling the links, and the user has enabled one of the link PTT lines, then the enabled link transmitter will follow the main receiver's COR signal. (Refer to your S-COM manual for the output enable commands.)

The link transmitter's 2N3055, a hefty NPN current driver transistor, drives the PTT circuit of the link's radio. The link controller will supply a ground to your transmitter PTT. It was not designed to handle the current of the link transmitter. If you need a high current PTT driver, use an external relay that will handle the current. A +12 volt line is supplied on the link controller's edge connector. Use this line for any low current +12 needs, i.e., a +12 volt PTT relay. If problems occur on either of the incoming links, you can simply use the Out 3 line to disable the links, shutting down the link section of the controller completely. If you do this, only the main receiver's COR signal is active on the link controller.

Controlling the Links

The link-enable line controls the two links. Using this line, you can shut off the links if, for example, the repeater that you are linked to malfunctions and stays keyed up. First, the controller would time-out after extended use, then you would enter the correct code to shut the links off. This way, the faulty repeater link won't time-out the main repeater system. After the problem is fixed, you can then re-enable the links and continue operations. This feature is especially useful at locations that are not easily accessible.

Once the links are working, how does the user identify which link is which? The S-COM 5K controller has 3 input lines to the main controller. These lines can be programmed to react to changes in their logical states. Link 1's COR signal is connected to Input 1 on the main controller, and link 2's COR signal is connected to Input 2. The main receiver's COR signal is connected to Input 3.

Using the S-COM 5K's macro feature, you can program the controller to change the courtesy tone to a different tone when the links become active. This is the easiest way to signal the user of an incoming link message. There are many possible ways to program these lines.

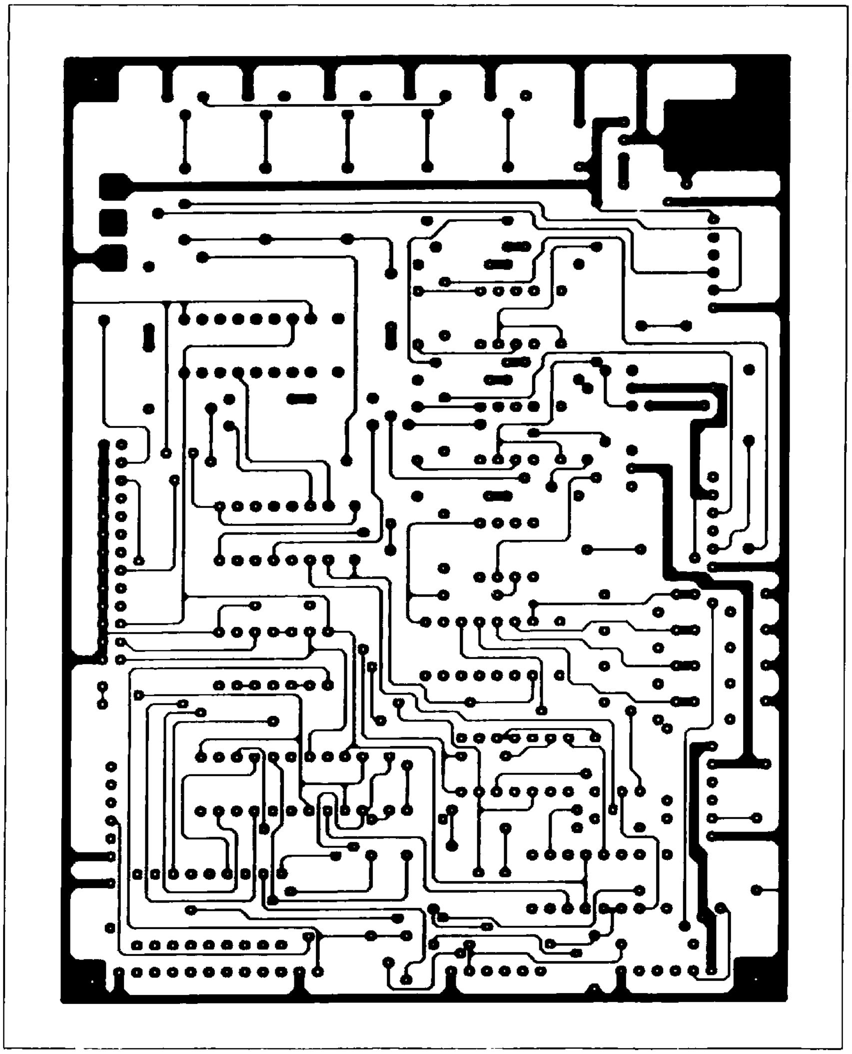


Figure 6b. Bottom foil layout for the main board.

Link Controller's Appearance

The cosmetics of the link controller are not complete without the lights. A 12-pin connector on the link controller's board lets you have external LEDs so that you can see what is happening on the link board.

Part of IC 5, the 74HC240 driver chip, sinks (supplies a low level) to the LEDs when the display is active. All of the current-limiting resistors for the LEDs are mounted on the link controller's board. Just add the LEDs.

If low power applications are required, special 1 mA LEDs are available with only minor changes to the link controller board. By changing the current-limiting resistors from 330 ohm to 4.7k ohm, and using special low power LEDs, you save 126 mA from the LED display board. The display section will show the main receiver's COR, both links' CORs, the main controller's PTT along with the two links' PTT, the two links' PTT enable, and the link enable's signal. This display feature will come in handy when programming the main controller or tracking problems in the repeater system. Just look at the display and presto, your questions are answered.

A Little Caution, Please

When constructing and handling the link controller board and components, remember that static electricity kills components. Use CMOS handling precautions. Always make sure that any static electricity is discharged from your body before touching any component or the main controller board.

Adjusting the Link Controller

Adjustment is simple and fast. To start out, adjust the three receiver level pots, VR 1, 2, and 3 to a 12 o'clock position. For proper adjustments, you'll need an auxiliary receiver that monitors the repeater's transmitter. Once the monitoring receiver is adjusted to an acceptable level, transmit a known level, such as a touch-tone from your hand-held, for a known level reference. Now open the squelch on the main repeater receiver, and transmit on the main repeater transmitter. Adjust VR 3, the level pot, of the main receiver on the link controller board, for a good level.

Once you have your main receiver adjusted *near* the correct point, transmit a touch-tone through the main receiver, and monitor it on the reference receiver. Now adjust the main receiver's audio level to match your reference level. If the level is too low, go to the main controller and locate the pot labeled RX and increase its level. Once the main receiver sounds good, move on to link 1 and adjust only its input level pot, VR 2. Continue with the same procedure as link 1 for link 2 adjusting only VR 1's level. You may need to play with the receiver levels and the RX level on the main controller to obtain a suitable audio balance.

Once the three receiver levels are adjusted, move on to the three transmitter levels. The main transmitter level, marked TX, is on the main controller board. This is the only adjustment used to control the main transmitter audio level. When you obtain a suitable mike level for the main transmitter, you need to adjust the two link transmitters. On both the links, audio levels are located on the link controller board. Link 1's output level pot is marked VR 5, and link 2's level pot is marked VR 4. To adjust their levels, input the appropriate code to enable the link portion of the controller, Out 3. Now input the code to enable the link transmitters, Out 1 and Out 2.

". . . remember that static electricity kills components."

To keep from overdriving your link transmitters' mike input, bypass the first mike amplifier section, and apply the links' audio at this point; you'll get cleaner audio on your link transmitter. If access to your mike amplifier is difficult, adding in a series resistor with the value between 50k and 100k ohms will keep the link controller from overdriving your link transmitter. Use your reference receiver to calibrate both of your link transmitters' levels, and use the same procedure when you adjust your link transmitter levels that you did when you adjusted your main receiver level.

Now input the same touch-tone on the main receiver's frequency. You enable the links so the main receiver will control the link's transmitters. Now adjust VR 4 and VR 5, the output level control on the link controller, so it matches the earlier observed level on the link monitoring receiver. Once link 1 is adjusted, proceed to link 2. Do the same adjustments for link 2 as you did for link 1. Once you have adjusted the levels, you should no longer need to do any adjusting on the link controller board.

Conclusion

The complete link controller and S-COM

5K system are currently in use on my 444.500 MHz and 147.380 MHz repeaters. With difficult access to the 147.380 MHz repeater site, I put plenty of care into the design and building of this link controller. I haven't had any problems with either the S-COM 5K or the link controller since transplanting them on the mountain. This controller was designed around the S-COM 5K repeater controller, but you can adapt it to any controller that has 3 logical outputs and 3 logical inputs. The combined link system and main controller, once built, totaled about $240. For a 2-link prioritized microprocessor-based repeater system, the price cannot be beat.

Both of the circuit boards are available from me. My address is 306 S. 20th St., Bozeman, MT 59715. The '5K Link Controller Main Board is $28.50 plus $2.50 S/H. The '5K Link Controller LED board is $7.50 plus $1.50 S/H. Both boards are $34.50 plus $2.50 S/H. The main board includes plate through-holes, solder mask, and parts ID mask. The LED Board is a non-plated through-board, but it comes with the appropriate ID mask.

The S-COM 5K Repeater Controller is available from S-COM Industries, PO Box 8921, Ft. Collins CO 80525-0700 (303-493-8316) for $189.

Happy home-brewing!

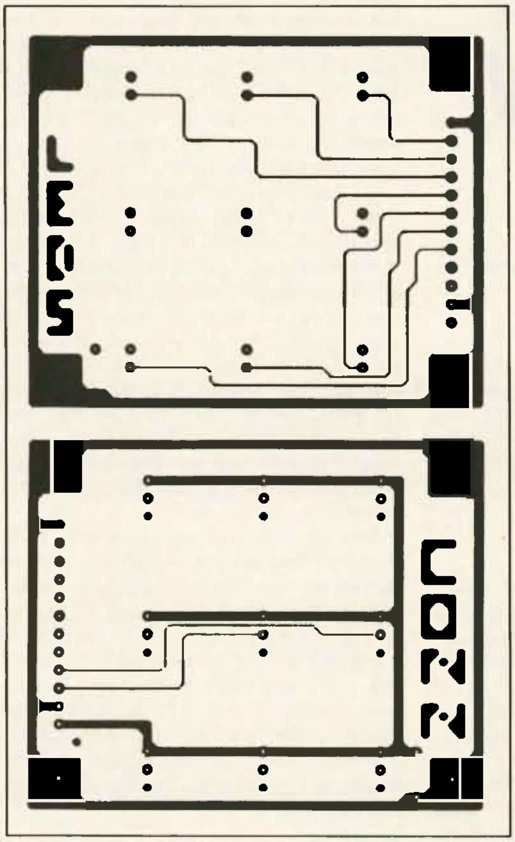


Figure 7. a) Top foil layout for the LED board. b) Bottom foil layout for the LED board.

The '5K Link Controller Parts List

ICs

	Quantity	Chip #	Description
7805	1	RG1	5 volt regulator
74HC08	3	IC 1, 2, 3	Quad 2 input CMOS logical AND
74HC32	1	IC 4	Quad 2 input CMOS logical OR
74HC240	1	IC 5	Inverting CMOS line driver
74HC123	1	IC 6	Dual CMOS multi-vibrators
LM741	3	IC 7, 8, 9	8-pin dip-packaged op amp
4066	1	IC 10	Quad CMOS analog switch

Transistors

2N3055	2	Q1, Q2	TO-220 NPN transistor

Resistors

Value	Quantity	Res. #	Style
10k ohm	5	VR 1,2,3,4,5	Variable res.
330 ohm	9	R 1,2,3,4,5,6,7,8,9	¼ Watt res.
10k ohm	9	R 14,15,16,35,37,39, 40,43,44	¼ Watt res.
100k ohm	4	R 12,13,41,45	¼ Watt res.
4.7k ohm	8	R 23,24,25,26	¼ Watt res.
47k ohm	2	R 38,39	¼ Watt res.
12k ohm	1	R 34	¼ Watt res.
1k ohm	5	R 11,18,19,21,22	¼ Watt res.
5.6k ohm	3	R 31,32,33	¼ Watt res.
2.2k ohm	3	R 10,17,20	¼ Watt res.
33k ohm	1	R 36	¼ Watt res.

Capacitors

Value	Quantity	Cap. #	Style
1 mF	8	C 1,2,3,7,8,10,13,16	electrolytic. cap.
0.1 mF	2	C 5, 6	disk cap.
0.47 mF	3	C 9, 11, 14	disk cap.
100 pF	2	C 12, 15	disk cap.
0.01 mF	11	C 4, 17–28	disk cap.

LEDs

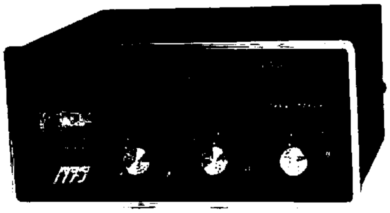
Type	Quantity	Diode #	Style
Red	3	D 4, 8, 9	Red - transmit
Yellow	3	D 5, 6, 7	Yellow - COR
Green	3	D 1, 2, 3	Green - Enable/Disable
5.1 V	3	Z 1, 3, 4	1N4733 5.1 V Zener Diode
15 V	1	Z 2	MPTE15 15 volt Zener Diode

Connectors

Type	Quantity	Conn. #	Style
wafer	6	CN 3,5,6,7,8,9	6-pin Modular connector
mate	6	CN 3,5,6,7,8,9	6-pin Modular connector
wafer	1	CN 4	12-pin Modular connector
mate	1	CN 4	12-pin Modular connector
male	1	CN 2	26-pin Ansley right angle
female	1	CN 2	26-pin Ansley cable crimp
male	1	5K connect	DB-25 male cable crimp
male	1	CN 1	3-pin Molex PC mount
female	1	CN 1	3-pin Molex crimp mount
cable	1 ft.	26-pin ribbon cable	

73 Review *by Marc Stern N1BLH*

The MFJ-931 RF Tamer-Ground



The MFJ-931.

MFJ Enterprises, Inc.
Box 494
Mississippi State, MS 39762
(601)323-5869
(800)647-1800
Price Class: $75

Getting it down to earth.

If you are one of the thousands of "cliff-dwelling" operators, you know how tough it is to establish a real RF ground, and how easy it is to establish a reasonable DC ground. Make no mistake about it, apartments or condos are more difficult to operate from; and RF and DC grounds are entirely different.

RF and DC Grounding

In a sense, a DC ground is also an earth ground; it is a safety path to earth. It conducts current away from equipment and keeps you safe. In a larger sense, it is one side of the circuit path that enables your equipment to work. Finding a good DC ground is usually a matter of simply attaching a ground wire to the third, or ground, wire in an electrical outlet. It's pretty straightforward.

On the other hand, finding an RF ground when your operating position is several wavelengths above the earth is next to impossible. The problem is your height above the ground. As your operating position moves more than a wavelength above the earth at your favorite operating frequency—quite likely if you live in a multi-story apartment complex—then it progressively gains a tendency to "float" above RF ground. This can create all kinds of havoc, including RF current loops and hotspots around the shack. The RF is looking for a path to a true earth ground, and is finding nothing. Therefore, it begins looking for what it considers to be the next best thing, which is just about any metallic object attached to your operating position. The result, as more than one operator has found, is burned fingers from RF on equipment. If the world were ideal, this would not happen, and RF would behave itself and take the path of least resistance out of your shack, into the ground, and into your antenna system. But the world isn't ideal and this problem has caused a great deal of grief for many cliff-dwellers.

Not knowing the peculiarities of grounding, many apartment-bound operators have made the collective mistake of assuming that, if they simply established a good connection to the cold water pipe, the RF problems would go away. This assumption may be based on the belief that cold water systems are all-metallic. However, given today's plumbing, it is more than likely that there will be a section of PVC piping somewhere in the system. This can effectively insulate the cold water system from the ground.

Higher Isn't Always Better

Let's assume that the operator's apartment or condo is several stories above the ground. Given this situation, it is more than likely the cold water piping will become part of the antenna system and will resonate at various frequencies, not necessarily the ones the operator wants. This might lead to RFI complaints and could cause the operator to QRT—not a great situation.

The classic way of solving this problem is to create an "artificial" RF ground of counterpoises, and to lay them around the shack or to run them along the baseboards. However, while this can effectively cancel the RF hotspots on the equipment and in your shack, it can also lead to other problems, most notably problems with children or animals coming into contact with hot counterpoise wire, or with apartment mates yelling about how messy things are with all the wires running about.

By now, you have probably assumed that there's only one solution—QRT—but that doesn't have to be the case at all. The solution comes from one of America's last suppliers of ham goodies: MFJ Enterprises, whose artificial ground solves this problem.

Compact Artificial Ground

The MFJ-931 Artificial Ground is really a "tuner" for your ground or counterpoise system. It may seem a little out of place to think about tuning your ground or counterpoise system for best performance, but it really does make sense. Just as you can tune your antenna system for maximum performance, you can also tune your ground system for best performance. Antenna systems and ground systems are analogous in many ways.

If you are a ham homeowner, you probably enjoy the luxury of a true earth ground right outside your shack window. Or, if it isn't exactly right outside the window, it's within a reasonable distance. The result is that all the stray RF currents that might be created by imbalances within your antenna system or your station are usually shunted right to ground and you never notice a thing. Now, translate that to the typical cliff-dwelling operator, whose ground may be a cold water pipe several stories above the ground. As has been noted, all the cliff-dweller is assured of is a good DC ground because this setup is almost guaranteed to produce a poor RF ground.

With the MFJ-931, you can tame this situation drastically: you can tune your ground system for best performance and maximum RFI suppression. By best performance, I mean that minimum RF current is roaming around the shack and maximum signal is going to the antenna system. For example, I've tried the MFJ-931 with a more-than-slightly-weird loop wrapped around a third-floor window. It has also been tried with an old Army surplus window-sill-mounted 72" whip, as well as a variety of resonant antennas. All of these antennas have been used for tests, three stories above the ground, with a ground system attached to the cold water system of the building.

Cooling the Hotspots

The results, after a couple of months of testing, are good. For example, when I used the MFJ-931 with the braid that I clamped to the cold water system, I found that various knobs and metal cabinets that had been slightly hot with RF had cooled down. The MFJ-931 had taken the RF hotspot on my equipment and moved it down the braid used for grounding. The RF had been moved to the copper piping of the cold water system. The MFJ-931 didn't create a true ground, but it did move the problem closer to the earth, where it belonged.

The ground wire became hot when RF currents were flowing. Realizing this, I used insulated wire wherever runs were exposed to the paths prowled by the cat that inhabits my shack. I would suggest insulating the wire and routing the ground cable away from the paths of any small children or pets that you have running around. If you do not, you chance having a tiny member of your family get a nasty burn.

As you can see, the MFJ-931 is no substi-

lute for a good earth ground. However, when you are a cliff-dweller, you have few other choices. True, the MFJ-931 doesn't make an antenna or antenna system perform any better—it can't. It does, however, greatly help cure RFI.

RFI Suppression

The MFJ-931 can be used two ways: directly with the ground system, or as a counterpoise tuner. Most operators will probably use the MFJ-931 in the first configuration.

I used the MFJ-931 in the "normal" configuration for the first part of the evaluation. In this configuration, the MFJ-931 moved the unwanted RF down the ground braid to the cold water piping. In truth, though, while this was a nice configuration for operating, it wasn't maximizing the MFJ-931's RFI suppression capabilities. RFI suppression was maximized when I used the MFJ-931 with tuned quarter-wave counterpoises. Incidentally, when I used it with the tuned radials, the unwanted RF on the equipment was also drastically reduced. Tuning the radials not only improved the performance of the antenna system, it also tuned out unwanted RFI.

Inside The MFJ-931

Look at the MFJ-931 closely and you'll see how uncomplicated it really is. The major parts consist of a 12-position tapped coil, two transmitting-grade air-variable capacitors, a toroid, and an RF sampling ammeter. Most of the major components are isolated from the chassis, with one exception that I'll get to in a minute.

All of this makes you wonder why someone hasn't thought of a device like this before, and it makes you realize just how ingenious a device the MFJ-931 really is. In the 931, MFJ has created a relatively simple device that works well, and which cures a couple of problems that have haunted amateurs for years.

Installed at your tuner, the MFJ-931 picks up the earth ground cable on one side and the normal tuner ground on the other. Alternatively, you can leave the earth ground cable where it is and install the MFJ-931 between your tuner's ground and a counterpoise system.

Once you've installed the MFJ-931, it's easy to operate. You simply rotate the inductor selector and watch the needle on the RF ammeter. When you see a peak in the ammeter reading, you know you've hit the right spot for resonance. After the inductor is tuned, rotate the capacitors to fine-tune the peak. Usually, you will find that this point not only indicates maximum current transfer to the radial or ground system, but it also shows the resonance for the antenna system as a whole.

As I noted, the MFJ-931 is well-built. Not only does it use quality components that can easily handle anything you throw at it (provided, of course, you don't try hitting it directly with 3 kW of RF), but it should also last for years. It is housed in an RF-tight aluminum cabinet. All the parts are well isolated.

A Drawback

I did spot one minor inconvenience as I used the MFJ-931: There is a certain amount of hand capacitance that can affect the settings. MFJ mounts the capacitor used to null capacitance on the front panel of the MFJ-931. It is isolated from the chassis by nonconductive fiber washers. This placement effectively raises the capacitance control above chassis ground and allows it to float in relation to the MFJ-931. The result is that once you have made your adjustments, you may see them change as you move your hand away from the controls. A good suggestion might be to move the control into the cabinet and mount it on the insulators. This should effectively eliminate the problem.

Docs

The brief documentation included with the MFJ-931 not only covers the installation procedures, but also makes suggestions about where to place the MFJ-931 and how to configure your operating system. It provides a readable overview of the problem that the MFJ-931 helps to solve. About the only thing it doesn't do is present you with a detailed schematic of the MFJ-931. I suspect that most operators probably won't miss the lack of the schematic, but I did.

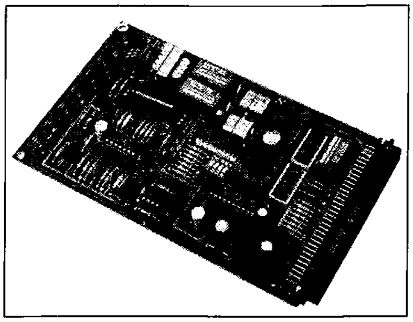
Overall, I'm glad I found the MFJ-931. It certainly cleans up hotspots and helps to make things far more pleasurable at the operating position. If you're in this situation, or if you need something for a DXpedition or vacation hideaway where there is no good earth ground, take the MFJ-931 along. You'll find it a good addition to your equipment. ■

73 Review

by Peter J. Bertini K1ZJH

Maggiore HPC-201 Repeater Controller

Maggiore Electronic Lab.
600 Westtown Road
West Chester, PA 19382
(215) 436-6051
Price class: $495



The HPC-201 repeater controller.

The Maggiore HPC-201 Deluxe controller and full-featured autopatch is moderately priced and powerful enough to seriously compete with controllers costing twice as much. Our club has five repeaters equipped with the HPC-201 controllers. The autopatch features alone justify the price. I will cover the controller first, and then discuss the autopatch.

Hardware

You can buy the controller with any of the Maggiore repeaters, or buy it separately. Two of our controllers are in Maggiore Hi-Pro Basic repeaters. Three other club machines, a Spectrum SCR-1000, a Spectrum SCR-77, and a GE Master Pro are using HPC-201 controllers. The controller card is only 3⅞″ by 6¼″ and the construction is first-rate. The controller requires 10–15 volts DC at 190 mA, and has provisions for battery backup. An LM324 assists with the repeater and autopatch audio chores and an LM555 audio oscillator voices the CW messages, courtesy, and warning tones. This oscillator also produces the reverse patch ring-out tones, and patch and repeater time-out warnings. The HD63P01 microprocessor with its piggy-backed ROM is the heart of the controller. Other chips interface the microprocessor to the real world. Seven 500-mA open-collector outputs are available for controlling external devices. You can use two auxiliary inputs for burglar and battery alarms, or phone line sensing. Complete documentation is supplied. The two COR and audio inputs are nice features which allow a link or control receiver to operate with the controller.

The Controller Command Set and Security

The controller currently supports over 80 commands. It would be impossible to cover all of them in this review, but I'll highlight the important ones. You can set just about every repeater parameter remotely, either through the phone line or on-the-air, using touch-tone entry. A five-digit security code precedes the command entry to insure security. The command codes are two digits (decimal values), and sometimes an operant follows the command to enter new hex values for timers, ID speeds, pulse-dial rates, etc. You may change the security codes at any time. If for some reason the security codes are lost or inadvertently changed, the trustee may use a second five-digit security code to reset the controller to its power-up parameters. The repeater responds with a CW "OK" to verify that it has accepted the command.

Firing It Up

On power-up, or when a master-reset command is given, the controller resets to specific default parameters. Most of these parameters can be preset when the EPROM is programmed at the factory. Defaults include all of the control and access codes for the repeater and autopatch. You can change the ID callsign at any time.

A special user access code allows members limited access to some of the repeater command codes, including three of the auxiliary outputs. This allows the regular users access to links, prerecorded messages, etc., without making them privy to all of the control commands and security codes.

The Full-Featured Autopatch

The autopatch may be open or closed access. Closed access requires a three-digit code to access or disconnect the patch. The repeater acknowledges successful patch termination with a multi-tone signal. It issues a warning warble ten seconds before a patch time-out. The autopatch timer may be set for either a five or ten minute limit, or unlimited patch time. You can set the patch to allow toll calls or seven-digit dialing. Also, you may specify the minimum and maximum numbers that can be entered for dialing. For instance, setting the minimum/maximum for a value of seven and eight allows local calls and limited long-distance dialing. The patch can also ignore either (or both) a 'Ø' or '1' first digit entry. Dial-a-porn 1-976 exchanges may also be inhibited.

On a PBX requiring a number nine to reach an outside line, the patch can dial the number automatically for the users. The HPC-201 also has a last number redial feature. When the controller shares the line with a home or business phone, or even another controller, a simple add-on circuit senses the line and disables the patch while the line is in use. The sensing circuit will also terminate the patch when the party called hangs up. The autopatch has two modes of reverse patch. Reverse patches may be disabled.

The Auto-Dialer

Up to 800 numbers can be stored in two auto-dialer memory banks. These numbers are stored in the same EPROM containing the operating program. Either bank can be turned off or on. The auto-dialer functions independently of the main patch. One bank is for user phone numbers and the second bank is for emergency numbers, although either bank may be used for any purpose. Long distance numbers may be stored and dialed by the auto-dialer regardless of whether the main autopatch parameters prohibit such calls. Special numbers, such as 'Ø' for operator or 911 for emergencies, may be in the auto-dialer. The time limit set for regular autopatches governs auto-dialed calls.

Other Features

The repeater will issue a warble-tone warning several seconds before, and just as, a time-out occurs. The autopatch dialing speed is variable; some electronic telephone exchanges will allow dialing up to 20-pps, which allows the operation to really speed up.

The Identifier

You can set this in either five or ten minute intervals. The identifier normally identifies on the repeater squelch tail, but it will ID over a long-winded user if the ID is past due. A special "alert" message may be appended to the beginning and end of the CW ID to warn users of impending severe weather.

Programming the EPROM

The first 25 autodialer numbers are programmed gratis. There is a small service charge for additional numbers. Some familiarity with hex numbering will allow anyone with access to an inexpensive EPROM programmer to change or enter their own phone numbers. Directions for phone number programming is provided.

A well-documented source listing is available. With this, you can begin changing defaults and call letters. There is no need for an assembler to do these tasks. The software is written in MC68701 assembly language. Every time I think they have done all that can be done with the HPC-201, a new software revision comes out with a feature we like. You can trade in your old EPROM for the latest version for a modest charge.

All in all, the HPC-201 repeater controller is a good bargain for the money, and we heartily recommend it. Write to me (20 Patsun Rd., Somers, CT 06071) or contact Maggiore for more information on its features.

73 Review *by Tom Gilchrist N7KHU*

The Heath HK-21 TNC

Hand-held TNC!

Heathkit
Heath Company
Benton Harbor MI 49022
To Order: (800) 253-0570
Store Location Information: (616) 982-3614
Price Class: $220; battery pack, $18

When I saw the ad for the Heathkit HK-21 TNC, I knew I just had to have one. Heath calls the HK-21 a "Pocket Packet" for a very good reason. It's a compact, self-contained TNC with a built-in personal packet bulletin board system (PBBS). It was just the excuse I needed to put together a portable packet radio system.

The system I finally built fits into a molded equipment/camera case, just the right size to take on vacations, business trips, or whenever I want to operate packet away from my base station.

Hardware Features

Heathkit sells the HK-21 already assembled. It's just as well, since, after looking inside, I'm not sure my hands would be steady enough to put this one together. Photos A and B show the main board, with ICs mounted on both sides.

The system is built around a Z-80A, software compatible ASIC (Application Specific Integrated Circuit). This 100-pin pack is soldered on the back of the main board (Photo B) and contains enough smarts to keep the total chip count of the TNC to only 9 packs. The other card is only half as long as the processor card and contains the modem and 5 volt DC power supply.

One of the first reasons to consider the HK-21 is its size. It measures 2½" wide x 1" high x 4¼" long with no cables plugged in. Add another two or three inches to cover the RS-232 DB-25 male plug on the back and the radio connection cable on the front.

With the internal battery pack, the unit weighs about 5½ ounces. The TNC is smaller and lighter than almost any 2 meter hand-held (HT). I added a strip of hook-and-loop fastener to the bottom of the HK-21 and to the back of my HT, and mounted the TNC to my HT (see Photo C).

While the compact size and weight are two of the most obvious visual features, the HK-21 has a number of internal features worth mentioning.

An Inside Look

First, the unit draws very little current. In standard 12 volt DC use, it draws a little less than 40 mA. This makes the unit just right for battery and solar applications. It works with external voltages from 10 volts DC to 13.8 volts DC.

The optional internal NiCd battery pack is rated at 120 mAh and is charged whenever external power is applied. In my system, the internal battery lasts for three to four hours of continuous use. This is more than enough time to go through two battery packs on my HT and just about the time it takes to deplete the NiCds in my Model 102.

Figure 1 shows the details of the front panel. There are two DIP switches on the panel which will turn off the power to the status LEDs and the RS-232 port. Turn off the LED switch to save battery juice. The RS-232 switch turns off the MAX-232 chip in the unit which converts the TTL serial level of the TNC processor chip to the +/− 12 volt DC RS-232 levels. Using the internal HK-21 PBBS software, you can turn off the MAX-232 when you are using the HK-21 as a dedicated digipeater or PBBS. I did a test that showed that turning off the LEDs adds up to 30 to 45 minutes to the life of the internal battery.

In my portable unit, I usually use an external 12 volt 2.5 VA Gel-Cell to power both the HT and the HK-21, so saving a few mA is no big deal. Also, I am used to watching the LED status indicators. Because the HK-21 uses differently colored LEDs for each status indicator, you can read the TNC status at a glance.

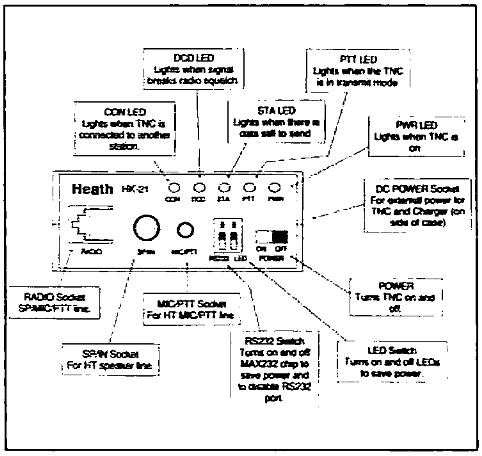


Figure 1. Details of the front panel of the HK-21.

There are also two radio connections on the front panel. The first uses a small telephone handset cord plug and includes the audio IN/OUT and PTT control lines. The unit has a miniature and subminiature plug for HTs.

The terminal connection uses a DB-25 connector and can be attached to a terminal or computer using an RS-232 level. The HK-21 cannot directly interface with TTL levels. Both *Xon/Xoff* software and RTS/CTS hardware flow control are available. The flow control will help you keep from losing characters when transmitting and receiving.

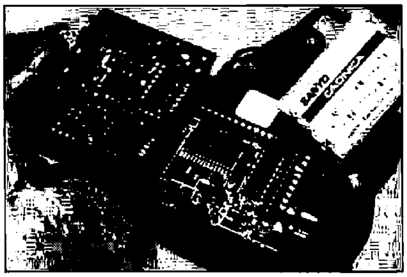


Photo A. Inside the HK-21.

Software Features

The HK-21 uses AX.25 software which you can set for the current level 2.0 protocol or the older Level 1. The unit is designed for 1200 baud VHF and UHF only; it will not work for 300 baud HF.

The manual states that the TNC uses the standard TAPR TNC-2 commands and is upload compatible. That is, if you have special terminal software designed to interface via TAPR TNC-2 standard commands, it should work.

The unit has an auto baud rate configuration for cold startup to get your terminal working with the TNC. Once you have the right baud rate, you can set the TNC to remember it on subsequent startups. The unit has a small internal memory backup lithium battery (not to be confused with the optional internal NiCd) which keeps your default command settings and PBBS data from disappearing when either the external or internal battery fails or is disconnected. The system has 32K of ROM

Photo B. The brains of the unit—the Z80A.

and 32K of RAM. The ROM contains the AX.25 and PBBS software (version 1.17 on my unit). The 32K of RAM contains, among other data, the system scratch pad memory, user command defaults, I/O buffers, PBBS data.

The PBBS

The personal Packet Bulletin Board System (PBBS) on the HK-21 is quite complete. You can post and retrieve personal and public messages. An outside computer isn't necessary; software and the storage of messages is part of the HK-21.

The system has about 15,000 bytes of storage for messages. Most of the messages I have on my system average about 225 bytes each. Based on this, the system will store about 65 messages. I don't think there is an upper limit to the length of a message, so a few long messages or computer listings could use up the memory. The unit was designed for a small personal PBBS, rather than a large, hard disk computer system.

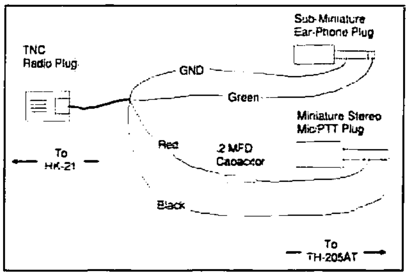


Figure 2. The TNC and HT work together by means of a telephone jack.

PBBS Commands

The table lists and describes the PBBS commands. The local terminal can use all the commands except HELP and BYE. If you have loaded the DAYTIME command with the current time and date at power-up of the HK-21, each message will be time-stamped. The time and date is kept by the computer within the HK-21, so when the unit is off, the current time and date information is lost. If you don't enter the correct time before connecting and sending (WRITE) a message, the time and date stamp will not be automatically attached to the description.

The PBBS has a callsign of its own. You set it up with the MYMCALL command. While it can have the same call as the MYCALL port, I find it is better to use a substation ID (SSID). I set my MYCALL to "N7KHU" and my PBBS MYMCALL to "N7KHU-1." This way someone else can use the PBBS while I am connected to other stations.

The PBBS can be activated and deactivated at any time on the local terminal by using the MBOD command. The PBBS does not lose any messages when it is turned off.

One of the nice features of the HK-21 is that you can store a message in the CTEXT buffer and instruct it to automatically disconnect after transmitting. A CTEXT message I sometimes use is: "I am not available, please connect to N7KHU-1 and leave me a message—73"

Before I go out, I set CMSG ON (send the CTEXT message) and CMSGD ON (disconnect after sending the CTEXT message). When a user connects to my node (C N7KHU), he gets the message in CTEXT, then he is disconnected. He then can connect to the PBBS (C N7KHU-1) and leave a message by typing W N7KHU. When I return home, I can turn on my local terminal and type MINE or MI to see if there are any messages, and use the n *n* (where *n* is the message number) to read the message. To delete a message, you use KILL *n*. Of course, you can connect to the PBBS via another packet radio system and list, read, and delete your messages. When you want to allow users to connect again, simply type CMSG OFF and CMSGD OFF.

Just like a large BBS system, the HK-21 PBBS keeps mail private. If you send a message to a specific call, only the sender and the receiver can read or kill the message over the air (however, the local terminal attached to the HK-21 can access and delete any message regardless of the sender and receiver callsigns). For public bulletins or messages, you can W ALL. Any station which connects to the PBBS can list and read public messages.

The HK-21 Manual

Heathkit documentation is known to be a cut above the ordinary. The HK-21 manual is one of the best TNC manuals I've seen. It is oriented to the new-to-average user of packet.

The first 30 pages tell you how to hook the TNC, radio, and computer or terminal together, and they give you tutorial sessions using all of the common commands. The bulk of the manual, 54 pages, details each of the HK-21 commands and their defaults, and describes how they work. The last few pages include a short troubleshooting table, command summary, schematic, and index.

The manual does not go into technical detail about packet radio or packet standards. To understand and use packet, you have to read some of the good books and magazine articles available on the subject.

I did find that the hook-up procedure for my Kenwood HT was not correct in the manual. I have a new TH-205A and it will not work with the directions given for Kenwood radios. This might be because the TH-205A is not like other Kenwoods. However, the general information and schematics were enough to get me by. See sidebar about the portable packet station using the TH-205A HT and the Tandy Model 100/102 laptop.

The schematic is very easy to read. The one drawback I found with it is that it should include placement of the jumper pads. Without this information, it's very difficult to tell the relationship between the PC board layout and the schematic.

The standard 8½" x 11" size of the three-ring binder makes the manual easy to copy and put in a binder with other equipment manuals and documents. The quality typesetting, graphics, paper, and printing give the manual a professional appearance. I always feel uneasy somehow about manuals printed by dot matrix.

Connecting the Radio

There are two ways to connect a radio to the HK-21. There is a miniature and subminiature phone jack intended for HT use. The PTT (push-to-talk) line is part of the microphone circuit. The second connection uses a small, 4-conductor phone plug (like the size used on a phone handset). This connector allows you to have separate PTT and MIC lines. This socket is intended for non-HT installations. In my case, I got my TNC and HT to work together using the telephone jack shown in Photo C. I used a small plastic barrel from a phono plug to house the 0.2 µF capacitor and to make the connections from the supplied HK-21 cable to the MIC/PTT and speaker cables (see Figure 2). Then I wrapped the barrel with electrical tape.

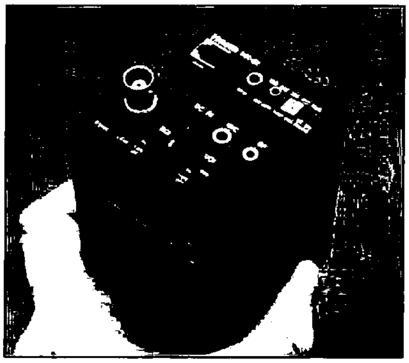


Photo C. The HT and TNC fastened together. Note the phone jack.

The computer cable I used for the Model 102 computer only needs lines 1, 2, 3, and 7 (pin 1 to 1, 2 to 2, etc.) because the internal TERM (terminal) program on the Models 100/102 is designed to handshake only with *Xon/Xoff* protocol. If you need to use the hardware

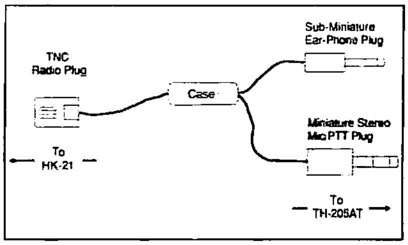


Figure 3. The TNC/HT interface physical layout.

flow control, you will need to use more lines. The HK-21 manual has instructions for most popular computers.

I use 1200 baud by setting the TERM STAT to "57E1E" on the Models 100/102 and setting ABAUD on the HK-21 to 1200. You can stop and start the display by entering CRTL S and CTRL Q in sequence.

There is one small problem with this system. The display will sometimes stop by itself. When this happens, the computer doesn't seem to want to talk to the TNC. If you type CTRL Q, the display will start again. This happens because the display on the Model 100/102 will not always keep up with 1200 baud packet. The computer automatically sends out an *Xoff* (CTRL S) when it needs to catch up. It then automatically sends an *Xon* (CTRL Q) when it is ready for more characters from the TNC. This seems to work just fine most of the time but, once in a while, either the computer doesn't send the *Xon*, or the TNC doesn't see it. The TNC just keeps waiting until you manually type CTRL Q.

The TERM software in the Model 100/102 allows you to upload and download ASCII text. You can also print out a hard copy. You can store files on a cassette tape or save them to disk with a 3½" disk drive.

Command	Mnemonic	Terminal *	Description
DAYTIME	DA	LOCAL	Used to set current time and date.
MYMCALL	MYM	LOCAL	PBBS call sign (and SSID)
MBOD	MB	LOCAL	Turn PBBS on and off.
BYE	B	RADIO	Log off PBBS.
MINE	MI	BOTH	List messages which are to you or from you. Gives message number, subject, time, and call (10 at a time).
FILE	FI	BOTH	Same as MINE except all messages are listed.
HELP	H	RADIO	Displays HK-21 PBBS help file.
?	?	RADIO	Same as HELP.
KILL	KI	BOTH	Kills a given message (by message number). Use a "%" or "&" instead of message number to kill oldest 10 messages.
READ	R	BOTH	Read a given message (by message number)
WRITE	W	BOTH	Write a message to a given station (by call sign). If no call sign given, message is to "ALL".

* TERMINAL Codes

LOCAL: Only computer or terminal attached to HK-21 RS-232 port can use this command.
RADIO: Only remote station using packet radio can use this command.
BOTH: Command can be used from either LOCAL or RADIO terminal.

NOTE: Mnemonics only used in LOCAL mode. The first letter of each command is used while remote station is connected to RADIO. Also, LOCAL mode inactive while a station is using the PBBS on RADIO.

The PBBS commands, with descriptions.

Concerns and Suggestions

As nice as the HK-21 is, there are a few "gotchas" that you should be aware of. Most are minor, some have to do with my preferences, and some might already be history by the time you read this.

First, my HK-21 came with mounts for the DB-25 connector hood that had the wrong threads. I informed Heath, and they sent me the right bushings. I don't know why I bothered to put the new bushings on; I don't screw the DB-25 hood on anyway! The HK-21 is so small and light, it will follow the connector and cord anywhere it wants to go (with or without the screws tightened).

The second problem was more serious. I was not able to use the TNC in my portable system on 145.01 because of a "birdie" or spurious signal introduced by the TNC into the HT radio. I found I could solve the problem by attaching an antenna mounted far away (like on the roof of the house). However, this was not suitable for portable and mobile use.

Contact with Heathkit produced the fix of putting a 5 pF capacitor across the 4.915 MHz crystal (connected to pins 65 and 66 of the IC-8 processor). This has allowed me to work the 144.99 and 145.01 MHz frequencies in my area. The birdie now shows up on 145.00, away from any packet frequencies.

While RFI (radio frequency interference) generated by the internal computer is a problem with all the TNCs I have owned, the HK-21 seems to be the noisiest. The plastic case has no shielding on the inside. If you have visions of using a short rubber duck antenna with the TNC strapped to the back to the HT, better think again. This configuration will not work unless you're right next to the station you're talking to. As mentioned in the description of my system, a more practical set up is to use an antenna a 3–12 foot distance from the HT, TNC, and computer. The farther away the antenna, the better the performance.

In my unit, I had some problems with the system memory losing its mind from time to time. I would lose all my PBBS messages and I would have to re-enter all my defaults. After this happened a few times, I looked inside and discovered that the battery had a loose connection to the PC board. After a quick solder job, the problem was fixed. The lithium battery should be good for at least 5 years.

There are small inconveniences one will find with any product this complex. However,

"The system is built around a Z-80A, software compatible chip."

there are two hardware features I find really annoying. First, the external power plug is on the side of the unit. For mounting in my case, it would have been better positioned on the back or the front of the TNC. In defense of the designers, I can see that the DB-25 plug takes up space on the back and the front panel is full! This brings me to my other annoyance.

Why did the designers use a standard DB-25 on the back of the unit? It adds two inches to the length of the unit. A telephone plug similar to the radio input on the front would have been perfect.

The HK-21's software has been exceptionally dependable. The unit has never tripped off into never-never land. However, some small quirks are worth mentioning. First, you can change the date from MM-DD-YY to DD-MMM-YY with the DAYUSA command. This is used in the MHEARD list and for time-stamping packets. However, the command does not change the date format in the PBBS. This is especially confusing because, when you list messages with the FILE or MINE PBBS commands, the headers only show the day and month (MM/DD). Thus, 12/11 always means Dec 11, no matter how the DAYUSA flag is set. When you use the READ PBBS command, the date in the message header is given as YY/MM/DD.

As far as I can tell, the unit is not compatible with Net-ROM EPROMS. It doesn't have a KISS command for use with TCP/IP systems, nor does the unit work with HF 300 baud packet. While these features are available on other TNCs in this price range, the HK-21 was clearly intended to surpass the size, weight, and current consumption of the competition.

Support

I have contacted Heathkit twice about my HK-21, once by letter (phone lines were busy all afternoon) and once at the ARRL Convention in Portland, Oregon. Both times they were able to answer my questions and solve my problems quickly. I have been happy with the quality of the product and the service.

As far I as know, at $219.95, the HK-21 is the most expensive UHF/VHF single radio TNC on the market today. Add another $17.95 for the HKA-21-1, an optional internal battery pack. If size, a built-in battery pack, low current consumption, and a built-in PBBS are features on the top of your list, you might well feel it is worth the price. I did. For me, the HK-21 is the perfect TNC for my portable packet station. ■

PACKET TO GO
N7KHU

To get a good idea of how you can use the portable features of the HK-21, you really need to see an example of a portable packet system. I have assembled a system which I use in my car (while parked), on out-of-town trips, during field day, and as a secondary home system. In Photo SA, the computer is removed, and you can see the complete system. The system contains the following equipment and hardware:

1 Kenwood TH-205A 5 Watt, 3 channel, 2 meter HT radio
1 Heathkit HK-21 "Pocket Packet" TNC
1 Radio Shack 32 KB Model 102 laptop computer
1 Pelican #1400 Waterproof Case w/optional panel mounts
2 Radio Shack #23-181 6 V, 2.5 Ah Gel-Cell cellular radio batteries
Hook-up cables

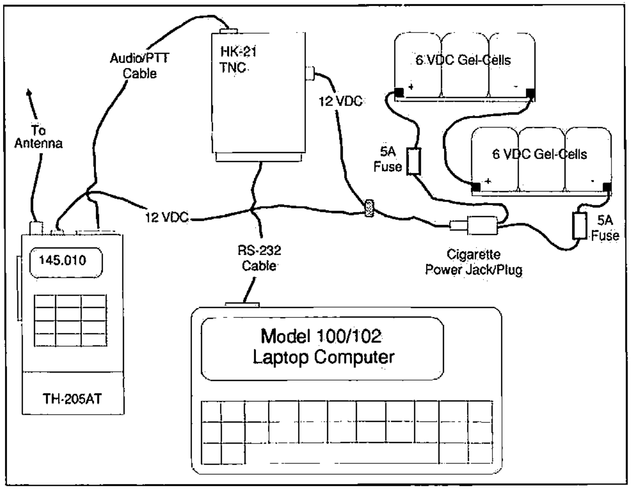


Figure S1. Schematic of the hookup, showing the batteries in series.

Photos SB and SC show the internal case construction. I found that having the external antenna cable directly attached to the HT was inconvenient. I bought a female-to-female chassis mount connector and drilled a hole just below the handle. The connector could have gone anywhere on the case, but I chose this position because of the internal layout of the components and the protection this area gave to the BNC jack.

In Photo SC you can see that I separated the batteries from the main equipment compartment with a piece of ¼" plywood. I glued it in place with quick-set epoxy (Radio Shack #64-2313). I glued the bottom foam liner, which came with the case, with contact cement to the main compartment and the battery partition. The partition and the foam gives the HT and TNC protection during transport.

The M102 computer rests above the equipment on mounting tabs, available directly from Pelican. The store I bought the case from knew nothing about them. Position the tabs 1¼" from the top of the bottom compartment. I used the quick-set epoxy to attach these tabs.

The Pelican case is available at many camera stores or by mail order (see the ads in camera magazines). There are holes for a lock on the case for security. However, I always put the case in a cardboard box when shipping it as checked baggage. This keeps the case from getting scuffed up. Also, the case looks valuable and Is an invitation for theft.

Figure S1 is a schematic of the general hookup. The 6 volt batteries are wired in series and use an inline "cigarette" type power jack (see Photo SD). The power cable for the HT and HK-21 has a matching power plug. This way, the HT and TNC can be powered from a car with the cigarette lighter outlet.

Photo SD also shows the complete hookup outside the case. Note that the antenna cord is not attached to the radio. The inline fuses on the batteries are hard to see in the photo, but they are shown in the schematic.

I use the 12 volt DC batteries because they will allow a full 5 Watts output on my HT and allow much longer usage compared to the HT battery packs. The life of the battery is about six to eight hours, depending on transmit time and battery temperature. I charge the battery using an A&A "Smart" Gel-Cell charger which I have set for 12 volts DC at 250 mA charge current. With this type of automatic charger, you can let the batteries charge indefinitely without damage. However, you can use a 200 mA to 500 mA 12 volt DC battery eliminator to charge the batteries if you watch the condition of the charge. You can do this by measuring the voltage across the battery while charging. Once the voltage reaches about 13.75 volts, the batteries are charged.

Overcharging will shorten the life of Gel-Cells. Gel-Cells do not take kindly to being discharged deeply, either. They like to be always fully charged, and they will last longer if you charge them soon after use, and don't discharge them below the level at which the HT "low battery" indicator lights up. My next project will be to mount a solar panel directly to the top of the case and charge the batteries with the sun!

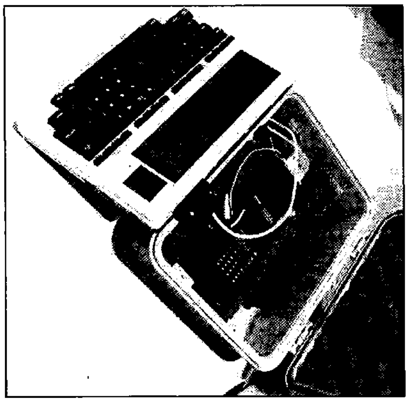


Photo SA. The complete system, with the computer removed so that you can see the TNC, HT, and battery compartment.

Antennas

I have tried a number of antennas with this system. The two I use the most are a portable J-Pole antenna, the SPARKY-J sold by Antennas West, and a quarter-wave mag mount.

The SPARKY-J unit is flexible and folds up to fit inside the case. You can attach it to a wall or place it outside. For best results, the antenna should be as high as possible and away from any metal objects. Tossing some twine over a tree branch and hoisting the antenna up works great for me. For more information about the SPARKY-J 2 meter antenna, contact *Antennas West, PO Box 50062-W, Provo UT 84605. Phone (801) 373-8425.*

I also use a mag mount quarter-wave antenna on the car. The quarter-wave performs well, but it requires a large metal object, such as the car, for a ground plane. The J-Pole needs no ground plane.

Photo SB. The external antenna cable is not connected directly to the HT.

Photo SC. Construction of the separate battery compartment.

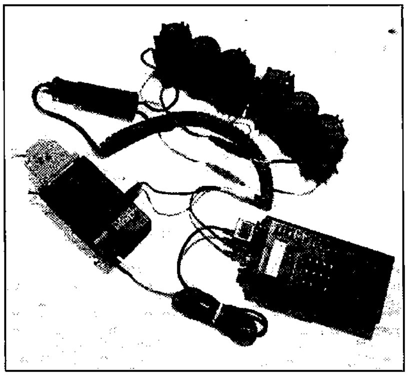


Photo SD. The HK-21, HT, batteries, and "cigarette" type power jack, all hooked up.

Breadboard a VCXO

Continuous 10 meter coverage from your CB.

by Walter R. Stringer N8BSG

Novices, and Technicians, of which I am one, may operate CW and other digital modes from 28.1 to 28.3 MHz, and CW and SSB from 28.3 MHz to 28.5 MHz. All the reported activity on this band lately made me want to get involved.

CB-To-10

To successfully convert my Lafayette Telsat SSB-120 citizens band transceiver over to 10 meter operation, I needed to build a voltage-tuned variable-frequency crystal oscillator (VXO) that could be varied over a 5 kHz range without losing its crystal stability. What I built, however, might be useful to anyone who desires a VCXO (Voltage-Controlled Crystal Oscillator). This mod helps you get the most frequency swing possible with a voltage tuning range of 0.0 to 12.0 volts. In my case, it led to continuous 10-meter coverage.

On the amateur 10 meter band, only the upper sideband is used for voice modulation. For CW operation, the AM mode could be used to cause the transceiver to output a carrier by keying the PTT (push-to-talk) line and not applying any modulation via the microphone. The same offset crystal is used for both USB and AM modes in most, if not all, SSB CB radios (including the one that I converted) so that, for a successful conversion, I had to worry only about getting one crystal frequency changed and working properly.

The Hitch

The CB channels, however, have a spacing of 10 kHz between them, and therefore the transceiver's PLL (phase-locked loop) circuit switches in 10 kHz steps. All SSB radios have a "fine-tune" or "clarifier" control on them for tuning in received signals, and there are conversions to allow that circuit to work during transmit as well. CB City International (PO Box 31500, Phoenix, Arizona 85046) is a very good source of CB-to-10 meter conversion information. Also check with *73 Magazine* for their list of 35–40 articles on CB-to-10 conversions.

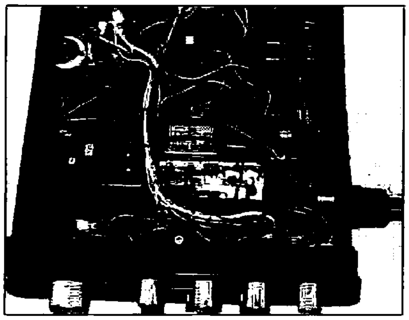


Photo A. The completed oscillator-buffer nestled in the converted CB transceiver, at front center of the rig. Tape the bottom of the board to prevent shorts.

For operation on the amateur 10 meter band, you need continuous frequency coverage, and to get that, you need to make each channel frequency-agile to the tune of 10 kHz, plus fill in any "missing channels". Fortunately for me, the output of the oscillator is doubled by the radio's circuitry, so even if I could get only 5 kHz of total oscillator swing I could cover the entire 10 kHz-wide channel. Now all I had to do was try to build a crystal oscillator that could be voltage-tuned over a 5 kHz range.

The Answer

The approach I used was to "breadboard" an oscillator circuit. When I got everything

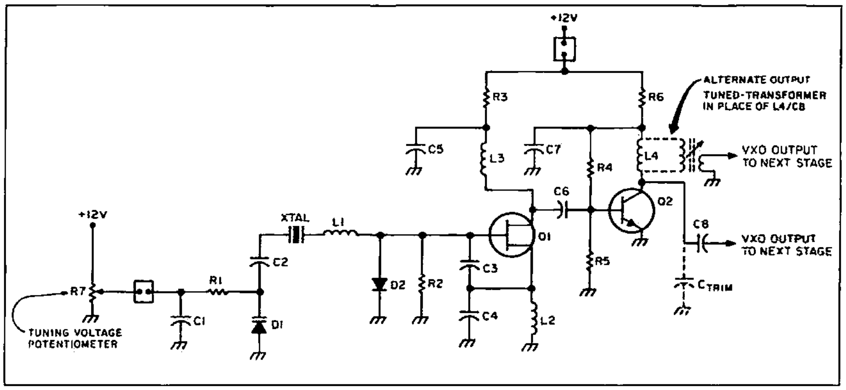


Figure 1. Schematic for the VCXO modification.

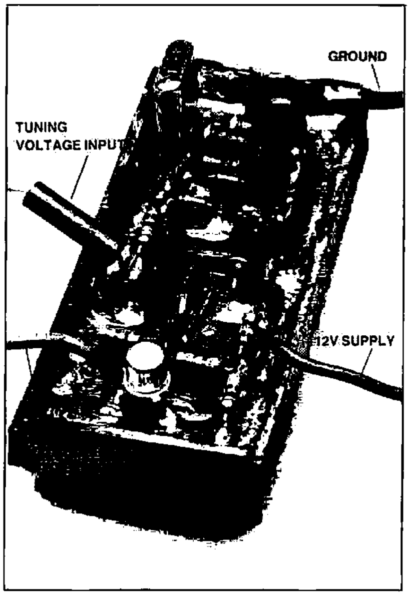


Photo B. The assembled VCXO mod.

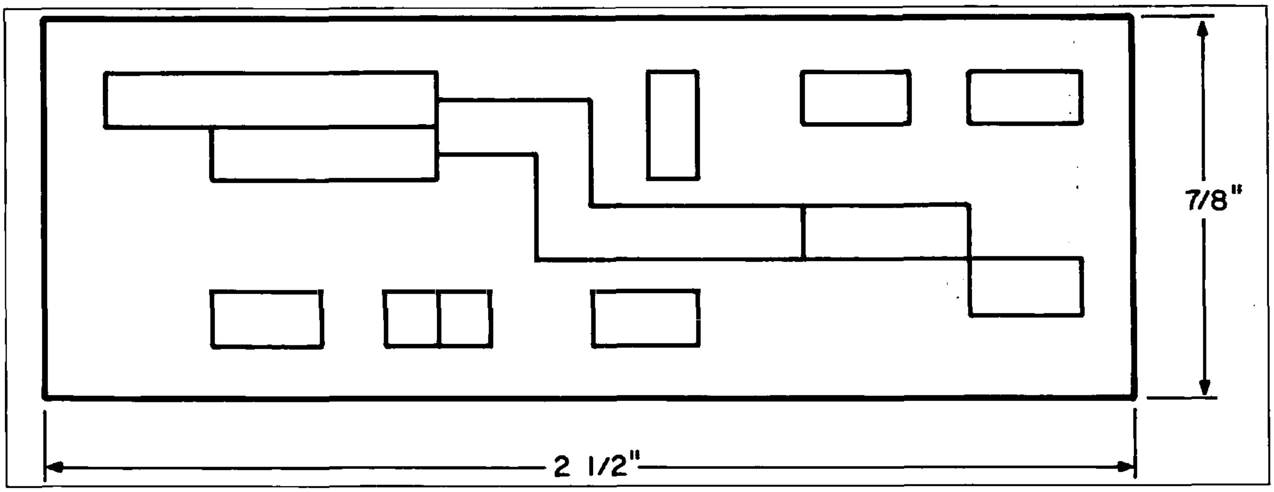


Figure 2. PC board foil diagram for the VCXO mod. The enclosed sections on the board are foil. Score between the sections with an X-acto knife.

working right (the frequency swing that I desired and sufficient output level), I installed it in the radio for the final test.

Figure 1 is the schematic of the VCXO mod. Figure 2 shows the etching pattern of the board. This can be "etched" with a ruler and an X-acto knife, or with a Dremel tool with a broken drill bit used as a router (my method). Figure 3 shows the parts placement on the board. Note that at the four sides of the board are strips of PC board soldered to join together the top and bottom ground planes of the double-sided printed circuit board. Photo A shows the completed oscillator-buffer installed in the converted CB transceiver. It may be necessary to put electrical tape on the bottom of the circuit board to prevent it from shorting anything out.

It is always good to first consult a reliable reference book when you are setting out to make a mod. Even if you don't find exactly what you are looking for, you may find something that does most of what you want, thereby making your job simpler. As my starting point, I looked under "VXO circuits" in the 1987 *ARRL Handbook*. (I believe that everyone who experiments with RF circuits should own a recent copy of the *ARRL Handbook*.) Included are "practical examples of crystal-controlled oscillators that can be frequency trimmed."

Crystals

I ordered two crystals of the same frequency—a 32 pF load capacitance (which is what is commonly used), and a 10 pF load capacitance. Both were HC-18/U style holders with wire leads from Marden Electronics Company, Inc. (PH: 800-222-6093). Even with 5-day "rush shipping," the cost was pretty reasonable, and I've had good luck with crystals from them. As it turned out, under identical conditions, I got 300 Hz more swing from the 10 pF crystal (3.9 instead of 3.6 kHz) and, since it would oscillate higher in frequency, I could tune it above and below the desired center frequency. With a 32 pF crystal, all or most of my range would be below the desired center frequency.

Parts List
Voltage-Tuned Crystal Oscillator

Q1	MPF-102	FET
Q2	2N2222A	NPN
D1	MV-209	Varactor Diode
D2	1N4148	
XTAL	10.32625 MHz Crystal, 10 pF Load Capacitance	
L1	10 µH	Coil
L2,L3,L4	100 µH	Coil
C1,C2	0.001 µF	Capacitor
C3,C4	25 pF	Capacitor
C5,C7	.01 µF	Capacitor
C6,C8	100 pF	Capacitor
R1,R2	100kΩ 1/4 Watt	Resistor
R3	390Ω ¼ Watt	Resistor
R4	47kΩ ¼ Watt	Resistor
R5	4.7kΩ ¼ Watt	Resistor
R6	470Ω ¼ Watt	Resistor
R7	50kΩ	Tuning Potentiometer, Linear Taper

One 2½" x ⅞" piece of double-sided printed circuit board
Two 2½" x ¼" pieces of double-sided printed circuit board
Two ⅞" x ¼" pieces of double-sided printed circuit board

The Right Varactor

I used a varactor diode in series with a .001 mF cap in place of where the trimmer cap would go to make the oscillator voltage-tuned. A crystal will block DC, so the .001 mF cap may seem unnecessary, but I prefer to use it anyway to prevent applying DC tuning voltage to the crystal.

I tried several different varactor diodes in the circuit to see which would give me the most frequency swing over a 0.0–12.0 volt range, and the best was the varactor diode that was used to modulate the 1.7–1.8 MHz RF carrier of an old Radio Shack cordless phone base unit.

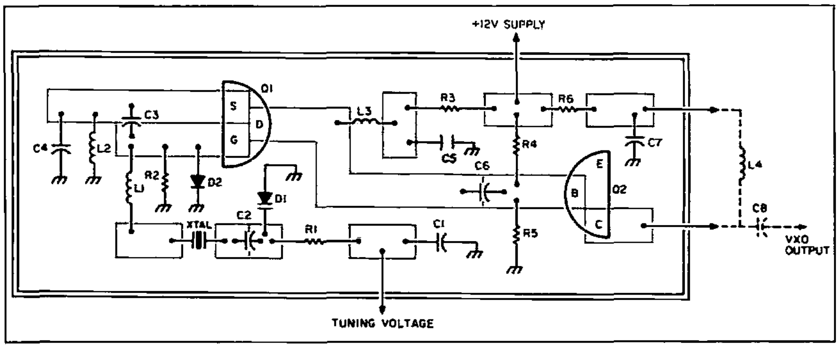


Figure 3. Parts placement for the VCXO mod.

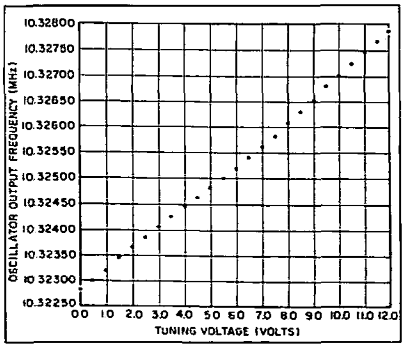


Figure 4. VCXO frequency output versus voltage tuning range. It is a very linear function.

A Motorola MV-209 varactor diode turned out to be almost as good. This is rated to up to 30.0 volts maximum. The diode is reverse-biased in operation. As the tuning voltage increases so does its capacitance, which in turn decreases the oscillator's frequency. If you wish to go up in frequency as you turn the fine-tuning (or clarifier) knob clockwise, you must wire the potentiometer up so that as you turn it the tuning voltage to the varactor diode decreases.

I experimented with the value of LI until I got the most frequency swing without losing the crystal stability (this is obvious when monitoring the oscillator's output with a frequency counter, as the oscillator frequency will suddenly take off). L1 adds about 400 to 500 Hz additional frequency swing.

The 1N4148 diode (D2) limits the amplitude of the RF at the gate of Q1. While this does decrease the output level of the oscillator, it allows approximately 1 kHz more swing than without it (3.9 instead of 2.9 kHz).

Which Coil?

The coil (L2) in the source circuit of Q1 can be anything from 100 μH to 1 mH. A 560Ω resistor there in place of a coil will result in an output with much less harmonic content (great, if you are interested in only the crystal's fundamental frequency). Any coil within the above range will give a slightly better frequency swing than the resistor.

Capacitors C3 and C4 are in series with L1, the crystal, C2, and the varactor tuning diode. Since in a series circuit the total capacitance will not be any larger than the smallest capacitance, C3 and C4 should be as large as possible, which allows the varactor diode to be the dominant influence on the frequency of the oscillator. The other limitation on the values of C3 and C4 is that, since any kind of trimmer capacitor across the crystal would limit the frequency swing of the oscillator, they together tune the crystal to the desired center frequency. When using the Colpitts crystal oscillator, I prefer to keep both feedback capacitor values the same, although many other places specify that the "bottom" (source-ground) capacitor be 3 times the value of the "top" (gate-source) capacitor.

In Praise of Buffers

I built a buffer stage to follow the oscillator. When working with oscillators for RF, I recommend always building a buffer stage. The cost of the extra transistor and parts is next to nothing, and you can use the buffer stage to really build up the level of your signal and also to filter out unwanted harmonics. The buffer stage also serves as a constant load for the oscillator. This way, all the oscillator has to do is oscillate, which is very important if you are trying to optimize it for something, such as for maximum frequency swing. When I installed the oscillator in the radio, I took out L4 and instead wired into the circuit the tuned RF transformer for the offset oscillator stage.

You can tune the buffer stage output by adding a trimmer cap, CTRIM, from the collector of Q2 to ground, which will resonate with L4. The same thing could be done with a trimmer cap from the drain of Q1 to ground, which will resonate with L3. At 12.0 volts, Q1 draws less than 0.5 mA, and Q2 draws 28 mA.

The oscillator's frequency output over the voltage tuning range is quite linear, as the chart (Figure 4) shows. Your "fine-tune" or clarifier potentiometer must be a linear type, however, as using an audio taper type will cause all of your range to be at one end of the dial.

Ultimately, with all of the experimentation, I was able to get 5.04 kHz of frequency swing out of the oscillator at the crystal's fundamental frequency.

Finis

During my conversion and troubleshooting I tested the rig in the AM mode with the PTT line keyed on and, with no modulation applied, measured all my frequencies on all my channels. A 10 meter SSB on-the-air test with my converted unit showed the conversion to be working fine.

So, there it is—a fun and cheap way to get a channelized CB on 10 meters. This band will be hot over the next few years, so I hope this mod will help you get in there and make good use of it!

Feed Point Protection

A little help for your bumper-mounted antenna.

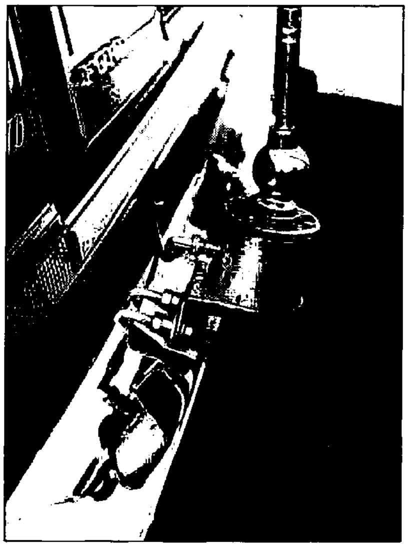
by W. C. Cloninger, Jr. K3OF

Several years of heavy mobile HF operating (100,000 miles and 100+ countries) can reveal much about mobile antennas and bumper mounts. I have used a number of different mobile antennas and combinations, including the regular Hustler resonators in both single and "candelabra" configuration, the Swan M34 multiband antenna in three and four band configurations, and finally a homebrew multiband antenna. ("Four Bands, One Whip," *73 Magazine*, April 1984, page 56.)

The performance of each antenna and combination was satisfactory and none seemed to offer any dramatic difference in either transmitted or received signals. There are some differences in bandwidth from one antenna to another, but my HF transceivers (solid state) did not substantially reduce output power until SWR was well above 2:1. Some of today's HF transceivers are much less tolerant of reflected power than the Atlas 210X and 210XLE's that I used. In the best of conditions, a mobile antenna is no match for your tribander at sixty feet, or even a good dipole, but mobile antennas still perform remarkably well with reasonable band conditions. Still, you want to ensure their continued peak performance.

Real Antenna Turn Off

I used only the Hustler bumper mount, but this one and a number of other mounts expose the feedpoint of the antenna to the elements. This feedpoint exposes these mounts to severe problems, particularly in winter weather. The culprits are wet dirt and salt. They will drop a S9+20 signal to an S5 or less. This will also play havoc with your transmitted signal, particularly if your HF transceiver is sensitive to SWR. Once salt has coated the antenna mount, it does not even have to be wet to cause problems. Ambient humidity provides enough moisture to allow the salt to conduct well.



A BNC connector for the enclosure makes it easy to attach coax to the mount.

The Solution

I solved this problem by protecting the antenna feedpoint from exposure to rain, dirt, and salt. I modified the Hustler mount to protect the antenna feedpoint by making an enclosure. I also added a BNC connector to the enclosure to make it easy to attach coax to the mount (see photo). BNC connectors are weather resistant, as are several other types of connectors. The ease of removing or attaching the coax was important to me because I have used the Hustler mount on at least ten different vehicles.

Construction

Figure 1 shows the construction of the enclosure I made for the Hustler mount. The core is a 2-inch section of 2½-inch diameter automotive exhaust pipe. I welded a top plate to the cylinder and cut out a section in the side of the pipe where I welded in a flat section to provide a good mounting surface for the BNC connector. For readers who don't have access to welding facilities, see Figure 2. This shows a non-welded method of construction. The plate at the bottom of the cylinder covers the large hole on the mount bracket and also helps center the cylinder assembly (Figure 3). There is no attempt to seal the bottom plate, as it easily keeps water from splashing into the enclosure and will allow any water which may seep in to run out the bottom. Paint all parts of the assembly to prevent rust.

The original Hustler gasket is used at the top of the mount. 10-32 x 3-inch screws secure the expanded assembly. Extra nuts and lock washers inside the cylinder at the underside of the top plate add stability to the assembly. Then assemble the ball mount and attach the center conductor wire from the BNC connector to the feedpoint on the ball mount stud.

The completed assembly is now attached to the bumper bracket with self-locking nuts, and the protected antenna mount is ready to pull in all those DX signals in all kinds of weather! ■

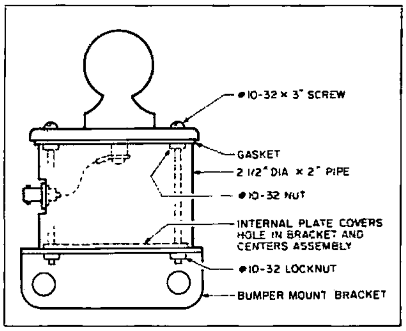


Figure 1. Assembly details of protected mobile antenna mount.

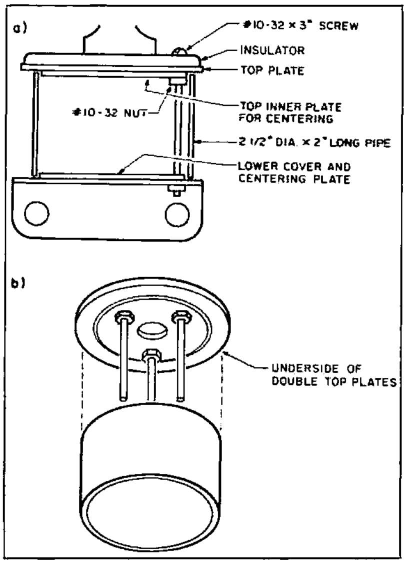


Figure 2. Alternate construction. This doesn't require welding.

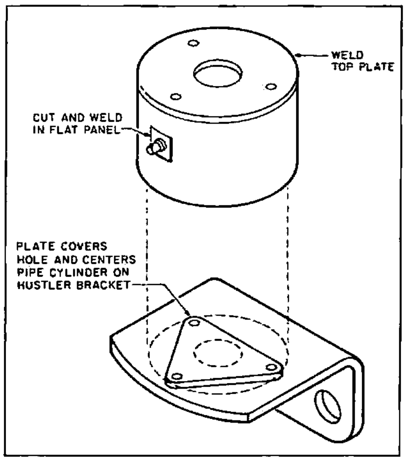


Figure 3. Lower plate covers hole in bracket and aids in centering the enclosure cylinder.

73 Review *by Pete Putman KT2B*

Yaesu FT-790RII All-Mode Transceiver

Go mobile at the drop of a hat.

Yaesu USA
17210 Edwards Road
Cerritos, CA 90701
Price Class: $800

Yaesu has consistently come up with innovative transceiver designs, from full-featured HF transceivers to dual band VHF/UHF hand-helds. Yaesu offers a line of portable all-mode radios for VHF operation, and we've reviewed the other two in the last year: the FT-60RII for 6 meters and the FT-290RII for 2 meters. The combination of a mobile, base, and portable transceiver all in one package is very appealing... especially for those of us who like to operate portable at the drop of a hat.

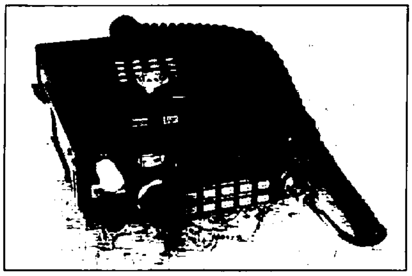
Now Yaesu has added a new face to the line with the FT-790RII, an all-mode transceiver for 430–450 MHz operation. It uses the same accessories as the 690R and 290R, is the same size, and pretty much operates the same way—which is to say it does its job very well even under some fairly adverse conditions. The 790R is quickly distinguished from its two cousins by the distinctive blue nameplate which reads "UHF" under the front panel BNC connector.

Overview

The front panel layout is very simple. Concentric knobs control power on, volume, and squelch. The largest knob controls frequency tuning and is directly below a miniature RF output/signal strength meter. Eight buttons below the main display do the bulk of the work, controlling the dual VFOs, the ten memory positions, high/low power, repeater offsets, noise blanker, tuning speed, and mode operation among other things. A clarifier (RIT) control is located to the extreme right of the front panel above the microphone connector.

The supplied MH-15C8 DTMF microphone also allows the operator to step through the memories or shift frequency with the UP/DWN buttons. These controls can be locked out via a rear panel switch if desired. An optional MH-10F8 speaker/microphone is also available without the DTMF function. Miniature phone jacks on the side of the radio allow connection of a remote speaker and a CW key (keying is automatic), and the front panel BNC connector is used for a whip antenna. Otherwise, a type N fitting on the rear housing is the standard antenna connection.

One comment regarding the microphones: It has been my experience with two of the MH-15C8 microphones that they do not hold up well under normal use. The first unit would not transmit anything remotely resembling a



The Yaesu FT-790RII is ideal for mountaintop UHF operation and makes a light package with the accessory FBA-8 battery case.

DTMF signal, and the LOCK switch on the second would not function correctly. The microphone supplied with the FT-790R has neither of these problems, however.

What makes the FT series unique is the modular approach used throughout the line. For mobile or base station use, the FL-7025 amplifier is connected to a battery or DC supply and up to 25 Watts output is available. The FL-7025 contains a power module and DC control circuitry wrapped up in an extruded aluminum housing that doubles as a heat sink, and is attached by two large latches to the body of the 790R. It's a small package and can be installed easily in most automobiles.

Takin' It With You

For portable operation, the user snaps the two latches to remove the FL-7025 pack. He then attaches the accessory FBA-8 battery pack using the same two latches and he's ready to go. The FBA-8 pack uses 9 C-size NiCd or alkaline cells and operation of the 790R is identical except for three things: (1) Power output is much lower, (2) The front panel lamp is disabled, and (3) The antenna must be connected through the front panel.

Power output with the battery pack is typically 3 Watts on high power. Is that enough for portable communications? For FM simplex and repeater work, it's more than enough. How about on SSB or CW? We'll find out in a moment.

Although the meter lamp is disabled, a button on the rear of the FBA-8 pack allows you to turn it back on momentarily or permanently—but at a higher rate of battery depletion. Yaesu supplies a flex antenna for the 790R called the YHA-44D which is fine for simplex or repeater work. For weak-signal operation, however, something with a bit more gain is called for at the BNC jack.

The FT-790R is equipped to store up to 10 frequencies in memory. The memory positions also store and recall repeater offsets, operating mode, and subtone settings from the FTS-7 subtone encoder. Note that only one subtone setting is possible with the FTS-7, and you will have to access the board through the rear of the main housing to make any changes.

The FT-790R offers three scanning options: VFO scanning, activated from the UP/DWN switch on the microphone; memory scan, which can scan all 10 memories or ignore any locked-out channels; and programmable scan, wherein memory positions 1 and 2 are used to define an upper and lower band segment to scan and tune through. Priority channel operation is also offered as is duplex operation for non-standard offsets.

You can select all of these functions from that 8 button keypad using a function shift key, marked clearly with a large "F" on an orange button. After using the radio for a bit, you can get good enough with these buttons to find the right combination without looking! All button strokes are reinforced with the usual audible "beep" and the "F" key has a distinctly different pitch.

The FT-790R covers the 70 cm band in two segments: 430–440 MHz, and 440–450 MHz. When in the first range, the display reads normally. Operation in the second range is indicated by the word "HIGH" under the VFO or memory indicator.

Three tuning speeds are available for each mode. In SSB/CW modes, the tuning rates are 25 Hz, 100 Hz, or 2.5 kHz per increment... more than adequate when used with the clarifier control. In FM mode, the steps are 12.5 kHz, 25 kHz, or 50 kHz. High speed motion around the dial is accomplished with the UP/DWN shifted push-button, which moves in 1 MHz steps.

Performance

As is the case with many small radios, the meter indications on the 790R don't reveal much. Early 290R and 690R owners complained that RF output was very low for the given microphone gain setting, and it took lots

of voice to move the meter. Similarly, received stations that appeared to be quite strong hardly budged the S-meter.

Let's dig a bit deeper into these issues. First, the RF power output is determined by one internal control, functioning as an ALC adjustment. The stock 290R could put out as much as 30 Watts by readjusting this control, and it appeared that SSB voice peaks were much higher on the front panel meter. However, the accuracy and response of such a small meter is not to be trusted. Inspection with both peak-reading and average-reading precision RF wattmeters indicated that the 290R was doing the job. And so it is with the 790R (see Data Table).

The second complaint pertains to the S-meter, and here it is well-founded. Received signal strength indications are lower than would be expected with the test signals used. All three of the FT series radios suffer from this malady, and I've also seen it on the ICOM '75 series VHF radios that sell for more than twice the cost of a 290R or 690R! Fortunately, you can recalibrate the meter if an accurate signal generator is available to a more realistic setting.

Performance Data
Yaesu FT-790RII Transceiver

Specification		Claimed	Measured
Receiver Sensitivity:	10 dB S/N SSB, CW	0.2 µV	0.16 µV
	12 dB SINAD FM	0.25 µV	0.2 µV
Selectivity, -6/-60 dB:	SSB/CW	2.4/5.2 kHz	n/a
	FM	12/25 kHz	n/a
Squelch Law:	SSB/CW	n/a	.45 µV
	FM	n/a	.12 µV
Signal required for 'S9':		n/a	3.5 µV
Transmitter Output:	High Power, FL-7025	25 W @ 8 Amps	25 W
	Low Power, FL-7025	n/a	4 W
	High Power, FBA-8	2.5W @ 1.5 Amps	3 W
	Low Power, FBA-8	n/a	350 mW

All measurements made with the following equipment: HP 608F generator, Bird 43 Thruline wattmeters, Bird Termaline coaxial resistor, Boonton 92 RF voltmeter.

In Actual Use

The 790R got its first big test during the 1988 ARRL UHF contest, where it and the 290R were backpacked up Cathead Mountain in the lower Adirondack Park of New York State. We fell twice on slippery rocks but the radios only suffered a mild jolt. It was wet and the threat of rain was constant, so conditions weren't exactly pleasant. I put up a Tonna 21 element yagi on two sections of 5 foot mast material and ran it directly into the BNC connector.

When not on 903 and 1296, I logged 15 contacts in 9 different grids in a four hour period with three Watts from the FBA-8 pack and a 16 dB antenna . . . mostly on SSB. Some of these contacts were made over paths exceeding 150 miles with S9 + 20 reports on both ends. The 790R certainly hears very well, especially with a good yagi in front of it. And 3 Watts? Plenty of RF, especially when you go mountain-topping! Receiver selectivity is surprisingly good, and dynamic range about average. Some hashing of the front end was observed from a nearby high-power multi-op station, but the sharp antenna helped considerably.

Conclusions

Easy! Another winner from Yaesu. If you like to operate 70 cm portable anywhere—camping, at the beach, on a boat—this is the transceiver for you. The small size of the 790R lends itself to any number of operating situations, and it packs a lot of punch for its size, whether you use the FL-7025 amplifier or go barefoot with the FBA-8 pack. Best of all, the price won't break your budget.

Mnemonic Morse

Code-hating computerniks take note!

by Roger B. Keeney W8LHL

A fellow Civil Air Patrol communicator called my attention to G. Harold Love's article, "Code Test Sure Shot," on page 10 of the July 1988 issue of *73 Magazine*. After starting off with some simple mnemonics to nail down the first few letters of the code, he then explained how to do a bit of contextual analysis to reconstruct the rest of the typical QSO-type message that had been copied as vertically written dots and dashes during the Novice code test itself.

Initial Ponderings

It occurred to me that there might be folks out there more interested in using their computers than their code keys to communicate by radio. A set of simple mnemonic phrases coupled to the letters of Morse code arranged in binary order would simplify matters greatly. As G. Harold Love suggested, "off-line" translation would be accomplished by copying the dits and dahs with vertical pencil strokes.

Disclaimer

Before continuing, a few words about no-code. The idea of a no-code license does not seem to be popular with the majority of the radio amateur community...yet. There are raging arguments on both sides. One of the best arguments going for CW is its DX capability, possible with the simplest equipment. Another is our obligation to maintain our proficiency at CW in the case that it's the best thing going during an emergency.

One of the arguments against no-code is the fear of having the ham bands trashed by no-coders in the same manner that CB was. Another fear seems to be seeing another person with a hand-held turn out to be just a radio operator, rather than a kindred soul who could talk with you, on your level, of the exhilaration of breaking through or avoiding the pileups by using CW.

My argument is that there's a pool of talented people who could make significant advancements in digital communications if they weren't being held back because Morse code might not be their bag—and I think that's ham radio's loss more than it is the computer hobbyists'.

The Evolved System

With this soap boxing out of the way now, let's get on with laying out the Morse code with the first sentence: "Even then, I ask no more." Notice how I'm portraying the dits and dahs vertically, which Love says is a much faster way of writing them. The initial letters are E (.), T (|), I (..), A (. |), N (| .), and M (| |). Adopting the convention of dits being binary zeros and dahs being binary ones, we count off the two single-element letters (which makes E a binary zero and T a binary one) and then the four letters composed of just two elements. Thus I, A, N, and M count off binarily now as zero, one, two, and three.

2^3

Looking next at the three-element letters, we find eight of these. Counting off binarily from zero to seven we have S (...), U (.. |), R (. | .), W (. | |), D (| ..), K (| . |), G (| | .), and O (| | |). The mnemonic sentence for these eight letters would be "Sing utterly real words; don't knock golden oldies." Like that? Hang in there, Morse fans. This gets even better when we get into the big league—four-element letters!

2^4

Now we're getting into the heady stuff, 16 letters made with four elements each. That's four bits batting out zero to 15 in the language of computers. Let's take the first eight, all starting with that first dit. H (....), V (... |), F (.. | .), * (.. | |), L (. | ..), * (. | . |), P (. | | .), J (. | | |). Notice that we have a couple in there that aren't ours. The letters depicted with asterisks do exist in one form or another in other languages such as Russian, Greek, or Arabic, whose larger alphabets are very glad to have our castoffs. So, when we go to make up our sentences, we will incorporate these foreign characters as dramatic pauses in our own continuing mnemonic English dialogue: "Have valued friends (pause) Laugh! (pause) Play jazz!"

We're on the home stretch now with the last eight beginning with dahs (actually six English and two more foreign): B (| ...), X (| .. |), C (| . | .), Y (| . | |), Z (| | ..), Q (| | . |), * (| | | .), * (| | | |). Bet you're wondering how we get the characters like X, Z, and Q into this final act, aren't you? So to the finish line we go with "Buy xylophones; create your zestful quartet (long) (pause)."

The real kicker's yet to come, but let's look at these four lines all together once before going on to the encore (see Figure 1):

Even then, I ask no more.

Sing utterly real words; don't knock golden oldies.

Have valued friends (pause) Laugh! (pause) Play jazz!

•	Even	•••	Sing	••••	Have	I•••	Buy
I	Then	••I	Utterly	•••I	Valued	I••I	Xylophones;
••	I	•I•	Real	••I•	Friends	I•I•	Create
•I	Ask	•II	Words;	••II	(pause)	I•II	Your
I•	No	I••	Don't	•I••	Laugh!	II••	Zestful
II	More	I•I	Knock	•I•I	(pause)	II•I	Quartet!
		II•	Golden	•II•	Play	III•	(long)
		III	Oldies	•III	Jazz	IIiI	(pause)

Figure 1. Chart of Morse alphabet letters, listed binarily.

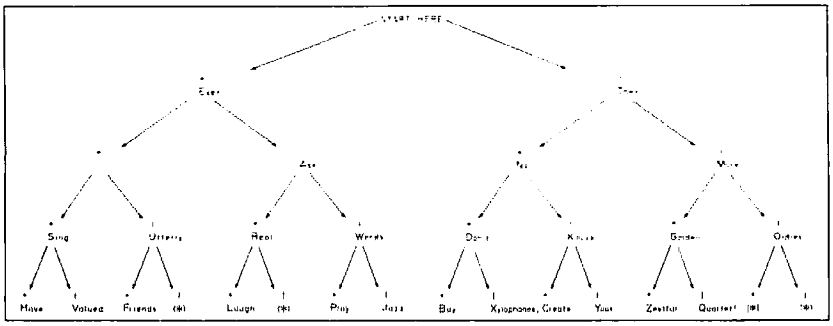


Figure 2. The Morse letter data tree, with the letters replaced by mnemonics.

Buy xylophones; create your zestful quartet (long pause).

Data Tree

One of the perennially favorite college computer science courses is something called "Data Structures." No course of this genre would be complete without a discussion of trees, usually portrayed upside-down, where the flow of data comes into one place at the top of the tree and then branches left or right according to the program logic in control at the moment. As it turns out, the portrayal of the characters of the Morse code as a tree has been around for a number of years. Most of you have probably seen this "oldie."

For decoding, you start at the top and move left and down if the next sound you hear is a dit or move right and down if it's a dah. Now we simply embellish this old-timer a bit by adding our mnemonic phrases (see Figure 2). The final product is this old classic tree chart made state-of-the-art by adding the mnemonic sentences to create a chart that's quicker to use than sequentially scanning a Morse code table ordinarily listed in alphabetical order.

As you can see, the chart gets crowded on the bottom row. I suggest drawing the bottom row first (you'll have 16 elements of alternating dits and dahs) and drawing upward. Don't worry about putting in the mnemonic phrases just yet, you'll do that last. Then leave a little space above that first row and lay down your alternating third row of dits and dahs (there are just eight elements now). Each element above will go between the two elements below it. The second row of four elements is then drawn before the remaining top row of just one dit and dah each is drawn to complete the data structure. Add the words "Start Here" above the top row to complete the chart.

Now start at the very top and add the words "Even Then" underneath the elements of the top row. (I suggest capitalizing every word now because it's the initial letter that you want to see quickly when decoding your message.) Then add the remaining sentences as shown in Figure 2. When you get to the bottom line, just use asterisks to represent the foreign characters because it will make that bottom row a little less congested.

The above is by no means the end of the potential for creativity that exists among the readers of *73 Amateur Radio*. Now it's your turn to see what you can do with these mnemonics to create even more effective (or whackier) and easier-to-remember memory aids. Don't forget also that I've only come up with about half an alphabet's worth of non-binary-based words and phrases. Certainly this list can be expanded.

I would like to think that I have simply picked up where G. Harold Love left off, and added my two-bits (or two dits) worth to this dialogue. I'm now looking to other readers for additional mnemonic aids to help open the doors of our hobby to those skilled in digital applications and for whom Morse code seems to be an unnecessary hurdle.

Grid Square Location Aid

This program aims to please.

by C. L. Houghton WB6IGP

Operation on any of our microwave bands above 2 GHz requires a means to determine compass headings to and from the station with which you want to make contact. Since most antennas in use at these frequencies are very highly directive, you need to know precisely where to point them to make contact with the distant station.

On short contacts of 10 to 15 miles, the pointing angle is not too critical. An error of 10 to 20 degrees will still provide reasonable signal strength when in the clear. When the path to cover is not line-of-sight, however, you need some pointing aid.

A common method is to lay out the pointing angle on a map with a ruler and determine the prospective compass heading to and from each location. This works out well, but requires quite a bit of time to figure out all needed compass headings. For contest time, a faster method is needed to determine distance points between contacts.

"The program will run on virtually any BASIC operation system."

Location Finder

The solution to this problem is a computer program (see list in sidebar) that provides you with the compass headings from and to the desired location of contact. In addition, it determines the distance between locations in miles and kilometers. This program was adapted from multiple sources by Leon Helms WA5BNH. The program will default to your location by changing the statement in sequence 30 and 40 to your latitude (30) and longitude (40). The program can bypass the default location and you can input specific information for lati-

```
10 REM ASSEMBLED FROM MULTIPLE SOURCES BY LEON HELMS WA5BNH 9/15/86
20 PRINT:PRINT:PRINT
25 MY$="MT OTAY"
30 DA=32.5958334#
40 DG=-116.8458334#
50 GOSUB 1000
60 PRINT"Do you wish to use lat/long or grid squares? (L/G)":
70 INPUT A$:IF A$ = "l" OR A$ = "L" THEN L=1:GOTO 100
80 IF A$ = "g" OR A$ = "G" THEN L=0:GOTO 100
90 GOTO 60
100 PRINT "Do you wish to use the default coordinates for your location"
101 IF L = 1 GOTO 110
102 LA=DA:LO=DG:GOSUB 1500
105 PRINT"  ":MY$:"    ":G$:"
107 GOTO 130
110 XX=DA:GOSUB 1600
114 PRINT XD:CHR$(248);XM;"'";XN;CHR$(34);" ":
116 PRINT NS:"       X    "::XX=DG:GOSUB 1600
118 PRINT XD:CHR$(248);XM;"'";XN;CHR$(34);" ":
122 PRINT WS:"   (y/n)";
130 INPUT A$:IF A$ = "y" OR A$ = "Y" THEN GOTO 190
135 IF A$="" THEN GOTO 190
140 IF A$ <> "n" AND A$ <> "N" THEN GOTO 100
150 PRINT:PRINT"Enter your location"
160 GOSUB 1100
170 DA = A2:DG = L2
180 GOSUB 1000
190 PRINT:PRINT"Enter other location name"
195 INPUT NA$
200 GOSUB 1100
210 K1 = L2:K2 = A2
220 PI = 3.1415926#
230 A1 = DA*PI/180
240 A2 = A2*PI/180
250 N = 1
260 LI = DG*PI/180
270 L2 = L2*PI/180
280 Q2=TAN(A1)*COS(L2-L1)-TAN(A2)
290 Q1=COS(A1)*(Q2/SIN(L2-L1))
300 X1=270+((180/PI)*ATN(Q1))
310 L9=L2-L1
320 IF L9 <=(-PI) THEN 360
330 IF L9 <=0 THEN 370
340 IF L9 <=PI THEN 360
350 GOTO 370
360 X1=X1-180
370 IF N = 2 THEN 490
380 L3=L2
390 L4=L1
400 L2=L4
410 L1=L3
420 A3=A2
430 A4=A1
440 A2=A4
450 A1=A3
460 Y1=X1
470 N=2
480 GOTO 280
490 C1=ABS(L9)
500 IF C1>PI THEN 520
510 GOTO 540
520 C1=2*PI-C1
530 REM arc cosine must be converted to equivilent form in basic
540 Z2=SIN(A1)*SIN(A2)
550 Z3=COS(A1)*COS(A2)*COS(C1)
560 Z4=Z2+Z3
570 Z1=-ATN(Z4/SQR(-Z4*Z4+1))+(PI/2)
580 Z1=Z1*180/PI
590 A=69.05*Z1
600 B=60*Z1
```

The BASIC listing of the grid square location program.

```
610 E=111.12*Z1
630 C=Y1+180
640 IF C>360 THEN C=Y1-180
650 Y1=INT(Y1*100+.5)/100
660 X1=INT(X1*100+.5)/100
670 A=INT(A*100+.5)/100
680 B=INT(B*100+.5)/100
690 IF K2 > 0 THEN S$ = "N" ELSE S$ = "S"
700 IF K1 > 0 THEN E$ = "E" ELSE E$ = "W"
705 GOSUB 1000
710 XX=DA:GOSUB 1600
720 PRINT XD;CHR$(248);XM;"'";XN;CHR$(34);" ";
730 PRINT N$;"  ";:XX=DG:GOSUB 1600
740 PRINT XD;CHR$(248);XM;"'";XN;CHR$(34);" ";
750 PRINT W$;
760 PRINT TAB(39);"to";
770 XX=K2:GOSUB 1600
780 PRINT TAB(43);
790 PRINT XD;CHR$(248);XM;"'";XN;CHR$(34);" ";
800 PRINT S$;" ";
810 XX=K1:GOSUB 1600
820 PRINT XD;CHR$(248);XM;"'";XN;CHR$(34);" ";
830 PRINT W$
840 LA=DA:LO=DG:GOSUB 1500
850 PRINT"  ";MY$;"    ";G$;TAB(39);"to   ";NA$;TAB(60);
860 LA=K2:LO=K1:GOSUB 1500
870 PRINT G$
880 PRINT
890 PRINT"Local true heading  ="Y1;"deg";TAB(40);
900 E=INT(E*100+.5)/100
910 PRINT"Distant true heading ="X1;"deg"
920 PRINT"Statute miles         =";A
930 PRINT"Nautical miles        =";B
940 PRINT"Kilometers            =";E
960 GOTO 190
1000 IF DA > 0 THEN N$ = "N" ELSE N$ = "S"
1010 IF DG > 0 THEN W$ = "E" ELSE W$ = "W"
1020 RETURN
1100 IF L = 0 THEN GOTO 1300 ELSE GOTO 1120
1110 PRINT"Please specify 'N' or 'S'. "
1120 PRINT"Enter latitude: Degrees,minutes,seconds,(N or S)"
1130 INPUT W1,W2,W3,I$
1140 IF I$ <> "n" AND I$ <> "s" AND I$ <> "N" AND I$ <> "S" THEN GOTO 1110
1150 IF I$ = "s" OR I$ = "S" THEN W1 = -W1:W2 = - W2:W3 = - W3
1160 A2 = W1 + (W2/60) + (W3/3600)
1170 GOTO 1190
1180 PRINT"Please specify 'E' or 'W'. "
1190 PRINT"Enter longitude: Degrees,minutes,seconds,(E or W)"
1200 INPUT R1,R2,R3,D$
1210 IF D$ <> "e" AND D$ <> "w" AND D$ <> "E" AND D$ <> "W" THEN GOTO 1180
1220 IF D$ = "w" OR D$ = "W" THEN R1 = -R1:R2 = - R2:R3 = - R3
1230 L2 = RI + (R2/60) + (R3/3600)
1240 RETURN
1300 INPUT "Grid square (ex. DM13ET) ";C$
1310 IF LEN(C$)=4 THEN C$=C$+"MM"
1320 ER=0:IF LEN(C$)<>6 THEN GOTO 1300
1330 FOR K=1 TO 6:A(K)=ASC(MID$(C$,K,1)):NEXT
1340 IF A(1)>90 THEN A(1)=A(1)-32
1350 IF A(2)>90 THEN A(2)=A(2)-32
1360 IF A(5)>90 THEN A(5)=A(5)-32
1370 IF A(6)>90 THEN A(6)=A(6)-32
1380 L2=-(180-(A(1)-65)*20-(A(3)-48)*2-(A(5)-64.5)/12)
1390 A2=-90+(A(2)-65)*10+(A(4)-48)+(A(6)-64.6)/24
1400 RETURN
1500 IF INT(LA/10)=LA/10 THEN GOTO 1700
1503 IF INT(LO/20)=LO/20 THEN GOTO 1700
1505 B(2)=INT((LA+90)/10)
1510 B(4)=INT((LA+90)-(B(2)*10))
1520 B(6)=INT((LA-INT(LA))*24)+65
1530 B(1)=INT((180+LO)/20)
1540 B(3)=INT(((LO+180)-(B(1)*20))/2)
1550 B(5)=INT((LO-INT(LO))*12)+65
1560 IF INT(INT(ABS(LO))/2) = INT(ABS(LO))/2 THEN B(5)=B(5)+12
1570 G$=CHR$(B(1)+65)+CHR$(B(2)+65)+CHR$(B(3)+48)+CHR$(B(4)+48)+CHR$(B(5))
1580 G$=G$+CHR$(B(6))
1590 RETURN
1600 XA=ABS(XX)
1610 XD=INT(XA)
1620 XM=INT((XA-XD)*60)
1630 XN=INT((XA-(XD+(XM/60)))*3600)
1640 RETURN
1700 N=0:L=0:O=0
1705 IF INT(LA/10) = LA/10 THEN N = 1:L = 1
1710 IF INT(LO/20) = LO/20 THEN O = 1:L = L+1
1720 IF N=1 THEN LA=LA+1/3600 :REM add one second
1730 IF O=1 THEN LO=LO+1/3600 :REM add one second
1740 GOSUB 1505
1750 CC=POS(C) :REM get the cursor position
1760 PRINT G$        :REM print on possible answer
1770 PRINT TAB(CC): :REM TAB BACK TO WHERE THE CURSOR WAS
1775 IF N=1 THEN LA=LA-2/3600
1780 IF L = 1 GOTO 1820
1790 GOSUB 1505
1800 PRINT G$        :REM print on possible answer
1810 PRINT TAB(CC); :REM TAB BACK TO WHERE THE CURSOR WAS
1820 IF O=1 THEN LO=LO-2/3600
1825 IF L = 1 GOTO 1505
1830 GOSUB 1505
1840 CC=POS(C) :REM get the cursor position
1850 PRINT G$        :REM print on possible answer
1860 PRINT TAB(CC): :REM TAB BACK TO WHERE THE CURSOR WAS
1870 LA=LA+2/3600
1880 GOTO 1505
```

The BASIC listing of the grid square location program (continued).

tude/longitude or grid squares, as it is all menu driven.

I used the program to assist a contact during the last 10 GHz microwave contest from Mt. Helix, in San Diego proper, to Heaps Peak, located near Lake Arrowhead in the mountains above San Bernardino. Entering the program, I selected the grid square option and omitted the default location and replaced it with my location at Mt. Helix—grid square DM12LT. The other station, contacted on the co-ordinating frequency on 2, stated he was located at DM14KF, Heaps Peak. The computer (Tandy 100) took 5 seconds to produce the following output:

DM12LT 32 X 48.30 N, 117 X 2.29 W TO
DM14KF 34 X 13.29 S, 117 X 7.29 W
LOCAL TRUE HEADING 357.22, DISTANT TRUE HEADING 177.17 DEGREE
STATUTE MILES 97.9, KILOMETERS 157.55

You can use this example to check out your system, once loaded, and verify proper operation on your computer. One note: Distance is computed from the center of the grid square.

"(The program) was a much welcome aid during microwave contest operations."

Versatile

The program will run on virtually any BASIC operation system. At present, it is used on a Tandy 100 laptop, a Kaypro CPM 2x, and some MS-DOS machines. For use on the Tandy 100 laptop, line 620 is deleted and a new line 620 is inserted as follows: (620 CLS).

This program allowed me to determine exact compass headings. It was a much welcome aid to help me aim my antenna towards the locations of unexpected stations that crop up during contest operation.

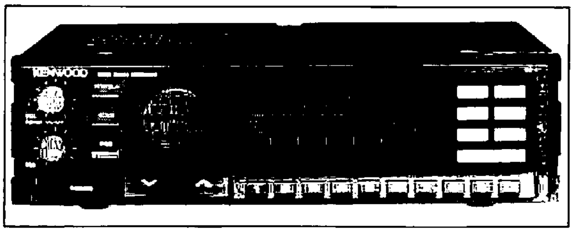
Normally I would have made available a disk or cassette, but due to the variety of computers being used—all taking different formats for input—I cannot reproduce a copy in your format. However, I will gladly send the program via modem. This seems to be the best method at present. WA5BNH has made the program fit into a Tandy PC-4 pocket computer with some re-assembling. Leon will make the PC-4 program available with or without the PC-4. Contact Leon Helms 10153, Ambassador Dr., San Diego CA 92126, for details.

Those microwave enthusiasts interested in obtaining more information about the myriad of 1 GHz and above operations going on in California, and around the world, may contact the author at the San Diego Microwave Group, 6345 Badgor Lake, San Diego CA 92119. Chuck WB6IGP also now writes a monthly column for VHF and above activities "Above and Beyond."

Number 16 on your Feedback card

NEW PRODUCTS

Compiled by Linda Reneau

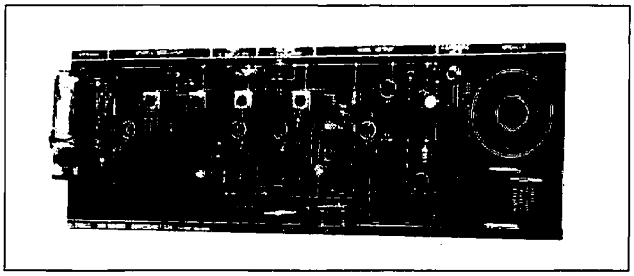


PRODUCT OF THE MONTH

KENWOOD USA CORPORATION
RZ-1

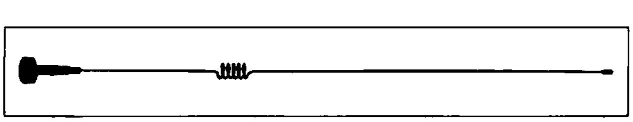
Kenwood's RZ-1 wideband scanning receiver covers 500 kHz to 905 MHz in AM, and narrow or wideband FM. The automatic mode selection function makes tuning easy. This new receiver features one hundred memory channels with message and band marker, direct keyboard or VFO frequency entry, and scanning functions, such as memory channel and band scan with four types of scan stop.

The RZ-1 is a 12 volt DC operated, compact unit with built-in speaker, front-mounted phone jack, switchable AGC, squelch for narrow FM, illuminated keys, and a "beeper" to confirm keyboard operation. Suggested retail price is $600. *Kenwood USA Corporation, 2201 E. Dominguez Street, Long Beach CA 90810. Phone (213) 639-4200. FAX: (213) 604-4487.*



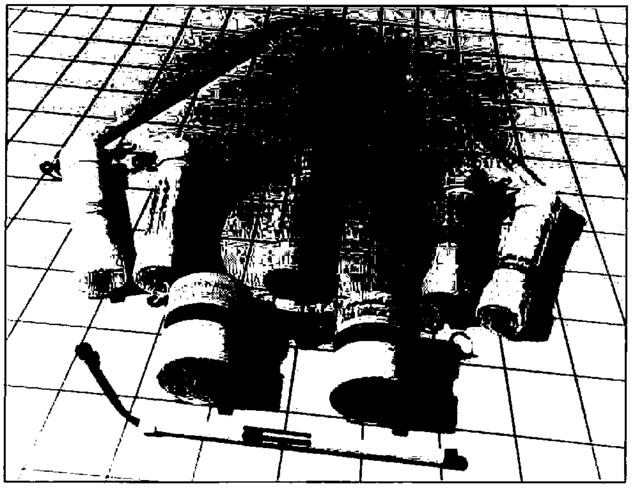
ELENCO ELECTRONICS, INC.

The Elenco Superhet 550 AM Radio Kit is a superheterodyne receiver of the standard AM frequencies. It uses seven transistors. By placing the parts over their corresponding symbols in the schematic drawing on the surface of the PC board, learning is enhanced during assembly. Included is an excellent assembly, lesson, and theory manual. Good project for classroom studies. Price, $20. *Elenco Electronics, Inc., 150 West Carpenter Avenue, Wheeling IL 60090. 312-541-3800. FAX: 312-520-0085.* Circle Reader Service number 202.



VALOR ENTERPRISES, INC.

Valor Enterprises' Model PUC 450 UHF collinear gain antenna features 100 Watt power rated Motorola base and silver-plated spring loaded contact. The unit has a 450–470 MHz frequency range. Price is $40. *Valor Enterprises, Inc., 185 West Hamilton Street, West Milton OH 45383. (513) 698-4194. Watts: 800-543-2197; FAX: (513) 698-7273; Telex: 724-389, Attn: Valor.* Circle Reader Service number 206.

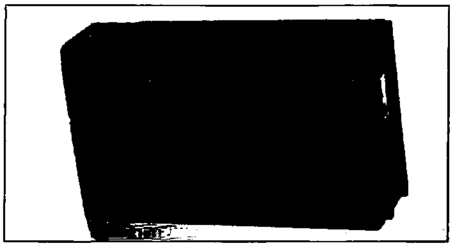


THE RADIO WORKS

The Radio Works now has a comprehensive balun line of ten different models. Three models have 4:1 ratios. The B4-1.5k ohm ferrite balun is general purpose, saturation resistant, and covers 80–10 meters. Five models have 1:1 ratios. These are all "current-type(c)" baluns. The "C-series" baluns are designed for retrofit applications in wire antennas and beams from 160 through 10 meters. The C75-2k and the C75-4k are 75 ohm models; they are the only baluns made specifically for the quarter-wave matching sections commonly found in Delta-Loop and Cubical Quad antenna designs.

The B1-2k and B1-4k models fill out the 50 ohm high power 1:1 line. They are suitable for wire antennas of all types. B1-2k and B1-4k are "current-type." The RemoteBalun(c) finally solves the problem of getting open-wire or ladder-line into the ham shack, and the Line Isolator(c) is useful for preventing RF current from causing feedback problems.

All Radio Works baluns feature rugged cases. If eye-bolts are used, they are stainless steel. All internal connections are soldered, and leads from the balun's windings are brought outside the case for direct connection to the antenna wire. Each balun is completely potted. Prices begin at $15.95. *The Radio Works, Box 6159, Portsmouth VA 23703. 804-484-0140.* Circle Reader Service number 204.



PERIPHEX, INC.

Periphex's super performance battery packs for the Yaesu FT-727R, 109RH, 209R/RH, 709R, 103R, 203R, and 703R include overcharge, over-temperature, and short-circuit protection, and a 1-year warranty.

The FNB-4SH, 12 volts 1000 mAh is double the capacity of the original pack, still with the full 5 Watt output. It is compatible with the Yaesu NC-15 base charger. Price, $71.

The FNB-4SL, 12 volts 750 mAh is 150% the capacity of the original pack, still with the full 5 Watt output. It is compatible with the Yaesu NC-15 base charger, NC-18B and PA-3 trickle charger. Price, $65.

The FNB-3S, 9.6 volts 1200 mAh is almost triple the capacity of the original pack. It is designed as a long life battery pack with the 3.5 Watt output. It is compatible with all three battery chargers listed above. Price, $60.

Periphex, Inc., 149 Palmer Road, Southbury CT 06488. (800) 634-8132. In CT: (203) 264-3985. Circle Reader Service number 208.

Never Say Die

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Please note the groups that are supporting this effort, since this shows they have a serious interest in supporting our hobby, rather than just viewing it as a business.

NIAC Members

Alinco Electronics Inc.
Buckmaster
Orion Hi-Tech
RF Parts Company
Universal Amateur Radio Inc.
Advanced Electronics
Applications, Inc.
Hustler Inc.
Gordon West's Radio School Inc.
Dayton Amateur Radio
Association, Inc.
Amateur Electronic Supply, Inc.
Communications Specialists, Inc.
Ramsey Electronics Inc.
Electronic Equipment Bank
ICOM, America
Electron Processing Inc.
G.G.T.E.
Ham Radio Outlet
P.C. Electronics
HAM-COM
MAXCOM
H. Stewart Designs

Poor, Dumb Wayne

A recent nationwide telephone/ repeater net discussed the 220 mess. I was asked to comment on the problem and suggested the use of 10 GHz to solve the allocation problems for repeaters on 450 and 220. This was dismissed as a dumb suggestion over the net, with the comment that I don't know any more about 10 GHz than the Commission. Well, dumb old Wayne now and then does his homework. My pontificating pettifogger hadn't.

Egged on by my long-time friend Chuck Martin KO1I, who did all the hard work building the rigs, we geared up a few years ago to see what could be done on 10 GHz. One of the reasons I moved to New Hampshire twenty-five years ago was the proximity of Mt. Monadnock, a 3165-footer, and Pack Monadnock, that runs 2310 feet high. Nice little rock piles to have near a known VHF/UHF fanatic.

Indeed, back in 1963 I put together quite a station on Mt. Monadnock, running 336 elements, and an AM kilowatt on 2 meters (with 2 kW modulation)—a 16-element collinear and a kW on 6 meters, and so on. I wanted to be heard, and I wasl A ham in Norfolk, some 550 miles down the coast, said my signal never went below S6, no matter how bad the propagation got.

We did a good deal of 220, 432, and even 1296 work up there. I don't think anyone had a more powerful 2 meter signal in the country. I could work walkie-talkies 300 miles away!

Eventually, the League got me off the mountain. That's a story I've gone into before, so I won't go into it again here. They sure used to pull some dirty tricks.

Anyway, when Chuck wanted to see what could be done on 10 GHz I was naturally excited about working with him. I went up on Pack Monadnock and he set up about 60 miles away on a hill near Boston. Even with a compass and two meter coordination it took almost a half hour before we finally clicked. When we were both pointed in exactly the same direction and on the same frequency, it was fantastic. The sound quality was incredible—and it was duplex! We could talk and listen at the same time. What a way to go. I hadn't been able to do that on amateur radio since 1938 on 160m when we'd assemble nets that could work duplex like that.

Okay, our 10 GHz gear worked. Now, how about trying it from Mt. Agamenicus in southern Maine? So Chuck drove over there one evening after work and we fished around for fifteen or twenty minutes before we made it. Then wham! Solid signals! And we were both running about 1/10 watt with no external antenna—just a little horn on the small transceiver box a few inches square.

Hmmm, wonder if it will work over a hundred-mile path? Chuck drove to the top of Mt. Washington one Saturday, about 103 miles away. He parked there, aiming his horn antenna out his car window. I sat on top of the Pack in my van, aiming my rig out my front window. It was so cold neither of us were interested in going outside. For some reason I never seem to do ham experimenting when it's warm or comfortable.

The aiming of the rigs was so critical we thought we weren't going to be able to make it. I had a map and a compass and was aiming at where I thought Mt. Washington ought to be. But was there a mountain in between that would stop us? It was difficult to be sure. We kept at it and suddenly we had a full quieting signal. We'd done it!

Vermont was next—Mt. Ascutney, over near White River Junction—well over 50 miles. We tried this the next weekend—it was getting easy by now. We clicked in less than ten minutes. But it was getting colder and I was freezing my galuccies standing up there on the stairway of the fire tower on top of the Pack at midnight, holding a 2 meter HT in one hand, flashlight under my chin and swinging the 10 GHz rig back and forth while calling Chuck as he tuned the band. Both of us had to have the little buggers aimed exactly right at the same time and on the same frequency. A few degrees off and silence. Back again and it was full dead quieting.

Next was Connecticut, a snap. Chuck found a good hill in northern Connecticut and we had state number five bagged. Could we do Rhode Island? It was not only much further away, it's a very flat state. The hills there are hundreds of feet, not thousands. The highest point in the whole state is 812 feet—Jerimoth Hill.

Just to give us an edge Chuck armed himself with a 3-foot dish to get some extra gain. With the help of Tim Daniel N8RK I lugged a similar dish to the top of Mt. Monadnock, giving me an extra thousand feet of elevation and a head start toward a heart attack—that's tough climbing. Chuck with the help of Eric Williams WA1HON, found the best hill he could in Rhode Island. It was wooded, so he climbed the tallest tree and aimed the dish with one hand, held the rig and tuned it with the other, held the branches with his legs and tried not to be blown out of the tree as the wind grabbed the big dish. Eric kept the 2 meter link going at the bottom of the tree. Despite the problems we made the connection—solid again. If both of us hadn't been suffering from the wind and cold, we might have tried it with just the little horns. I'm sure it would have worked, even over that poor path.

Now what? We'd managed all six New England states. New York was the obvious next step. Our topographical maps didn't show any clear path between anywhere in New Hampshire and New York. Well, perhaps from Mt. Washington to Whiteface Mountain—but that was chancy. We decided to try it from Mt. Monadnock to a high point just over the border from Massachusetts in New York. It meant pushing the signal over a mountain to do it, but it was worth a try.

So Chuck and Eric chugged over to New York and got set up. Tim and I climbed that miserable mountain again, chancing cardiac arrest. I panted and sweated my way up. Sherry came along too, but she couldn't quite make it to the top—too tough a climb for a grandmother of 11 kids.

To help matters the top was fogged in solid, so all I had to go by was a compass. We set up the 3-foot dish on a tripod, aimed it by the map and coordinated with Chuck on 2m. We started tuning and calling. Bingo! Again a solid S-9+ signal. We couldn't believe it. There was no way for the signal to be going direct—it had to be bending over Mt. Greylock. Seven states on 10 GHz! Well, seven states for me—and one state for Chuck.

We could have made it to Canada from Mt. Washington, but we weren't sure the "glory" was worth the aggravation. And besides, it was by now so late in the fall that getting up on Mt. Washington would have to wait for spring anyway.

How about 24 GHz? This was supposed to be much more difficult, with weather affecting it more, but so little ham experimenting had been done that no one had data on it. So Chuck borrowed a couple of 24 GHz rigs from Microwave Associates, the outfit that made the diodes that made the rigs work.

We tried 'em on the NH/MA link and had problems. The rigs just weren't working right. Before Chuck could fix 'em politics reared its ugly head. One of the hams at M/A, a League fanatic, put on pressure to keep us from using the rigs. He didn't want *73* to get any more glory. That should be saved for *QST*. The result was that Chuck chucked the project in disgust and, with no driving force to make it happen, 24 GHz dropped dead.

So now, those who are convinced 10 GHz will never be able to replace 220 and 450 MHz links, let's come up to date about twenty years. Are you living in the past and damaging ham credibility with the FCC by not knowing what you're talking about?

One of the strong reasons given on the net for us keeping the 220–222 segment of the 220 band was a little-known and very private western (Condor) repeater network. I used the parent of this setup almost twenty years ago when I was able to talk using a 2 meter HT from a street corner in Las Vegas and talk with hams in

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Never Say Die

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San Diego, San Francisco and Phoenix in a round table. This was the Gronk Network—a monumental pioneering effort that was kept far too secret.

Today the same linking system seems to be going, but with no improvements of which I'm aware. This means that in time of a serious emergency—and providing none of the mountain-top repeater links are knocked off the air or deprived of power, they'd be able to handle maybe twenty messages an hour. Great.

Well, we've had some emergencies. Have you ever read of the Condor Net providing public service? Please advise.

We're just a tad behind in technology when you consider that Ma Bell is now sending 117K baud over a normal twisted pair. That's about 100 thousand words per minute. With some simple encoding we could up that to about 350,000 words per minute that we could push through our repeaters. With that sort of capacity we might be of some value in a serious emergency. At twenty messages per hour, let's forget it and go back to smoke signals.

Our "Full" Bands

We suffer again from credibility when we claim that the 450 band is "full" in some areas of the country. Now, this may really be true, but no one has bothered to document the situation in print that I recall, so therefore the concept is suspect. Publish or perish again.

I travel around the country a good deal, lugging an HT with me as I go. In every city I visit I make it a point to say hello on every repeater I can access. I manage to get a reply in perhaps one out of ten—at best. When I'm up in a private plane I check all channels for activity. Up there, where I can hear for a hundred miles or so and there are several repeaters on every channel, it's busier. But I sometimes get the idea that the trend is toward one ham, one repeater.

If the Southern California repeater and remote base ops actually are using every 450 channel efficiently, it would be well worth the effort to do some research and write an article. I'll publish it and make sure the FCC sees it. But, lacking such data, it's not difficult to imagine that there is more politics in play than cooperation.

I've visited the area often over the last 40 years—even considered moving out there one time because I had so many friends there and I enjoyed the spirit of adventure that I found there. In recent years I found this area to be by far the worst example of how bad amateur radio can get—in bad language, threats and a breakdown of the fraternal spirit of cooperation that has been the real power of our hobby down through the years. The recent 220 coordination conflict in Southern California may have contributed substantially to the FCC's decision to take away 40% of the band.

It does look as if the FCC were being moved by political (lobby) pressures more than reason. Fighting city hall through the courts, as the ARRL has threatened to do, might win. Well, there goes a big lump of that rainy day money they've been packing away. They sure do awfully well for a non-profit outfit, with millions salted away—have to hand it to 'em.

Whether we hams have a legitimate need for the 220-222 band is arguable. If one goes by what data is available—what's been published—it looks as if we're hearing hot air. And ditto for the claims that 450 is packed solid.

If the FCC has any idea of turning over this band for compandered sideband (CSB) then I believe they're being given a crock. That's a mode of communications that hasn't proven practical—and that despite strong League support. *QST* published articles on it—quickly put it in the Handbook—and gave it their support. Engineers looked at the system and gave it the horse laugh.

I hear about 56K packet experimenting—about 9600 baud packet being used more and more—yet how many articles am I getting about this work? Well, the FCC gets their idea of amateur radio from looking at the ham magazines. What do they see? Not much.

Several clubs have been doing a wonderful job of attracting and licensing youngsters. How many have you seen written up in the ham magazines? Not many. So how's the FCC to know? And, without some PR on the subject, how can we expect other clubs to get the idea and start to follow suit? The general impression is that it's impossible—it can't be done. Well, it's being done, but those doing it are silent.

I heard hams on the 220 net saying that 1200 MHz wouldn't work for repeater and remote base links. How would they know? Have you ever seen an article in a ham magazine on the subject saying the band would or wouldn't work? For that matter, now and then I see signs that there are groups experimenting with our microwave bands—some setting remarkable records. How many published articles have you seen by these pioneers? It seems as if there are those who do and those who write, but few who do and write.

If the repeater groups insist on playing the game close to the vest, they're going to lose the game. Whether we keep our bands or not is a matter of politics, not engineering, so we've got to play the politics game. This means a lot more than an indignant letter to your congressman. It means using the media for PR. It means articles in *73*—which I'll see that the FCC and congressmen get. It means PR over your local radio and TV stations. It means not only doing service in emergencies, it means making sure the networks and press associations know about it.

Field Day is a natural. Or it would be if you started your planning for it at least four months ahead. You not only need to plan for power, antennas and towers, rigs, tents, food and accommodations, you need to plan your photos and write-ups for the ham magazines and local press—plus sound bites for local TV. They may even be able to get it onto the network for you, if you've planned well.

I've done a video on how to do PR—sells for $99 and has gotten great praise from many buyers. One key to getting into the media is to do as much of the editor's work as possible. Editors are busy and, like the rest of us, will let others do as much as possible of our work. The easier you make it, the more you'll get published. Anyone with a business of any kind would do well to check out my video. It should, with little added expense, help you to generate at least an extra million dollars in revenue per year—just by the sneaky use of PR, which I describe in detail.

I believe that if the FCC saw any convincing sign that amateur radio could get into a growth pattern—could attract youngsters and might eventually have some use for our frequencies for other than the amusement of a dwindling group of old men, we wouldn't have any further serious problems with them.

So, instead of bitching about our loss, I suggest we learn from it and get cracking on rebuilding our hobby. We need new, young hams—by the tens and then the hundreds of thousands. We need to take our work with packet and develop it into a high speed practical communications system that can be used to handle the traffic load a serious emergency will bring. Our 300 baud packet is a crawl. The 1200 baud is better—a wobbly walk. The few 9600 baud circuits are more like it. The rumored 56K baud experimenting needs more light and promotion. We haven't done much to be worth our salt in 25 years, so it's about time we tried to at least catch up with Ma Bell and the commercial world. Then we can move ahead of 'em and have something to brag about that's real.

In dealing with the FCC, please remember that the commissioners are political appointees, not engineers. Thus they tend to respond to political more than engineering pressures. Remember too, that ham problems such as our recent 220 California coordination mess are a royal pain, so the natural tendency for the Commissioners is not to bend over backwards to be nice to us. We're often a major FCC aggravation, but with few redeeming benefits that are immediately apparent. And when, from their viewpoint, they try to help us, we respond by viciously biting the hand that's feeding us.

If we would think first in terms of solving our problems instead of immediately trying to dump them on the FCC, we might not find them considering ham frequencies when the commercial firm lobbyists start pushing.

I hope all that makes sense—now let's get started with exploring 900 MHz and writing articles on it. Let's start easing the pressures on 450 with 1200 MHz and up links. While not every 450 link may work on 10 GHz, my experience tells me that most of 'em will—and with far better service than at present. We've got 500 MHz up there to use and, as far as I know, there's not one single ham actively using the band. What a waste!

So we have repeater groups at war, complete with lawsuits over 450, when the equipment for 10 GHz is cheaper and more dependable. Weird.

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, MD, WA3AJR
6 Jenny Lane
Baltimore MD 21208

Here in Maryland, many snowy and icy days will come before the end of March, and yet, at the same time, we can see the spring buds forming on the trees. It is still winter, and yet it's spring, too.

In our hobby, the simile is not lost. The amateur world in general, and the RTTY community in particular, has quite a variety of snowy, icy, warm, and sunny folk. As we look toward completing the twelfth year of RTTY Loop, I find myself wondering who you, the readers of RTTY Loop, are.

Therefore, I hereby introduce the first duodecannual RTTY Loop survey. This is a bit unlike any survey you've ever seen, but then again, this column is probably a bit unlike any other as well. So, feel free to photocopy and scribble in the margins, write out the answers longhand on a yellow pad, or put them in a text file on an MS-DOS, CoCo or CoCo/OS9 disk and send them to me at the above address. Adventurous souls can even E-mail their survey via CompuServe or Delphi; see the end of the column for details.

So, if you are ready, here we go. Just follow the numbers and directions given for each question. If this all works out, we will be together at the end.

RTTY Loop Survey

1. Are you currently on RTTY? If the answer is YES, go to question 2; if the answer is NO, go to question 8.

2. Are you using a mechanical teleprinter? If the answer is YES, go to question 3; if the answer is NO, go to question 4..

3. What model of teleprinter are you using? Proceed to question 4.

4. Are you using a computer on RTTY? If the answer is YES, go to question 5. If the answer is NO and you are NOT using a mechanical teleprinter, go to question 7; the answer is NO and you are using a mechanical teleprinter, go to question 10.

5. What kind of computer are you using? Proceed to question 6.

6. What computer software are you using? Go to question 10.

7. Well, then, what are you using on RTTY? Go to question 10.

8. Have you ever been on RTTY? If the answer is YES, answer the following questions as applicable to your past experience and go to question 2. If the answer is NO, proceed to question 9.

9. Are you planning to get onto RTTY? If the answer is YES, answer the following questions as applicable to what you plan to do, and go to question 2. If the answer is NO, go to question 16.

10. Do you use a separate terminal unit? If the answer is YES, go to question 12. If the answer is NO, proceed to question 11.

11. Then what are you using to decode RTTY? Answer and then go to question 13.

12. Which terminal unit are you using? After answering, proceed to question 13.

13. What bands do you like to operate on? After answering, proceed to question 14.

14. Do you operate on AMTOR? After answering, proceed to question 15.

15. Do you operate on packet? After answering, proceed to question 16.

16. What topics would you like to see covered in future editions of RTTY Loop?

17. Are there any topics you think we devote too much time to?

18. Do you have or use a computer for other than RTTY? If the answer is NO, go to question 22. If the answer is YES, proceed with question 19.

19. What kind of computer do you have?

20. Are you active on any computer bulletin boards, national or local? If the answer is YES, go to question 21.

21. Which, if any, large scale boards are you on?

22. This is the end of the survey. Please feel free to add any comments you would like.

> **"...any communications software, such as you would use with a telephone modem, is fine to set up a data controller/computer for RTTY operation."**

If all goes well, I should be able to put together some sort of analysis of this survey by the June or July issue, given both the delay many of you will generate before responding, and the lead time of the magazine. Please try to respond, each and every one of you. It is through reader feedback that I gauge the direction of future columns.

TRS-80 Model I

Here's one of those letters that I only hope some of you readers, somewhere, can lend a hand with. Dan Johnson KG4MD at the Naval Hospital in Norfolk, Virginia, wants to get his TRS-80 Model I computer set up to operate on RTTY. He has been having troubles with the interface between the computer and the terminal unit.

He was given an interface board with no documentation, and was told that there was a connector missing from the board as well. The logo CSS A-O Rev A is on the board. Dan describes the board as being populated with 12 integrated circuits, nine resistors, 10 capacitors, one voltage regulator, a slide switch, an eight-position DIP switch, and a 5.0688 MHz crystal. U1 is a 74LS155, U2 a 74LS367, U5 and U7 are 74LS244, U3 and U4 are 1489s, U12 is a 1488, U8 is a 74LS00, and U9 is a 74LS04.

Dan is looking for an identification of this board, and, hopefully, some interfacing information. From the interface chips (1488 and 1489) on the board, it certainly sounds like the right interface board, but I come up blank looking for details. Can anyone out there help? Send the information to me here at RTTY Loop, and I will try to forward it to Dan, as well as to the readership at large.

Apple II-e

Here's a note from Byron Schulten NO3X in Cumberland, Maryland, whose question fell to the bottom of a tall stack of mail. Byron is interested in putting his Apple II-e's onto RTTY, with either a Kantronics KAM or an AEA PK-232 RTTY modem. I know of no reason why either setup wouldn't work just fine, Byron. About any good communications software, such as you would use with a modem on a telephone communications service, should work just fine. There may be some specialized packages out there, and a few questions in local user groups or on Apple bulletin boards may be all you need to turn up some reasonably inexpensive solutions. Good luck, and look to hear from you in the future.

RTTY Loop Index

Many of you have requested the RTTY Loop index, and have found hidden treasure in the compiled list of the first 12 years of RTTY Loop. A request and self-addressed, stamped envelope will get you a copy of this compendium. I look forward to your questions, and answers to the survey, either by mail or E-mail. I hang out on CompuServe, ppn 75036, 2501, and Delphi, username MARCWA3AJR. I try to answer E-mail immediately; I have been known to be a bit longer with conventional communications.

April is next month, no foolin'! And with it comes spring, and the desire to see interest in this hobby blossom. I'm proud to say that for many of you, RTTY Loop is where you turn to key into the forefront of amateur technology. Keep that subscription current; with that tease, you wouldn't want to miss April's RTTY Loop. 73

Number 18 on your Feedback card

CIRCUITS

Great Ideas From Our Readers

Have a quick'n'easy circuit idea? Share it and get a one year subscription or extension to *73*! Clearly mark all entries as submissions for Circuits to distinguish them from manuscripts. Send your entries to Circuits, *73 Magazine*, Peterborough, NH 03458.

29 MHz Amplifier

Ten meters does not require huge power. The 10 Watts from my Asden 2800 was a little skimpy, however, so I built a pair of 6146s to follow it. The circuit is very conventional, and I constructed it in a case that once held a battery charger. As long as you are neat in your physical layout, you could build it in almost anything.

The only adjustments that require close attention are input, output, and neutralization. All the rest are one-time, set-and-forget adjustments.

The 150 pF capacitor in the input line compensates for impedance mismatch. You tune for maximum signal transfer from exciter to final. (Use an in-line meter or external field strength meter.)

The final is conventional Pi-network. I used two 75 pF APCs because I had them and they fit well, but a single 150 pF cap would work as well. You need nearly full capacity in either case.

When neutralized, the plate current dip should be at about the same setting of the 20 pF plate capacitor as maximum output. This is often difficult to obtain with tetrodes, but you can usually come close.

Power supply can be whatever you have handy or can build. The one shown used an old TV transformer from an RCA color set of about 1968 vintage. Adjust bias to let tubes idle at about 30 mA. (See Figures 1 and 2.)

Bruce Cameron WA4UZM
Temple Terrace FL

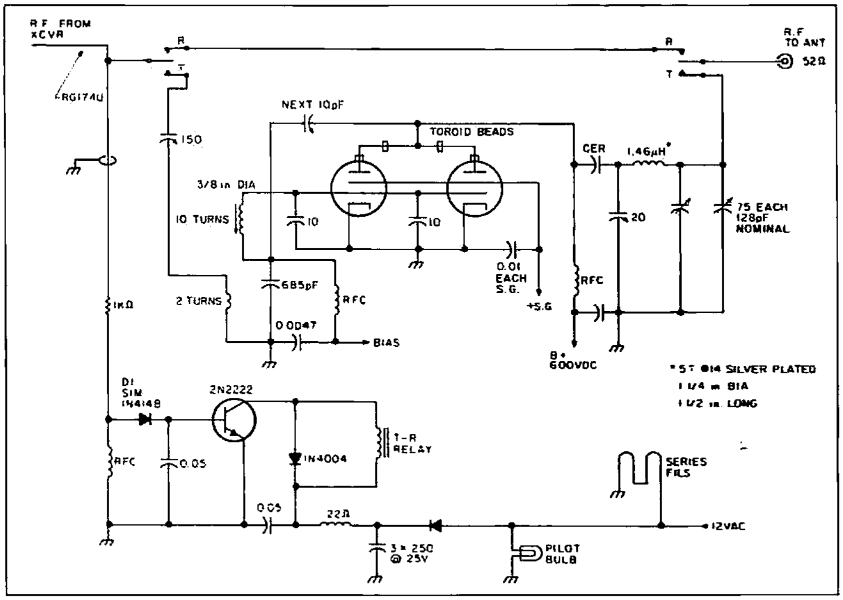

Figure 1. 29 MHz amplifier.

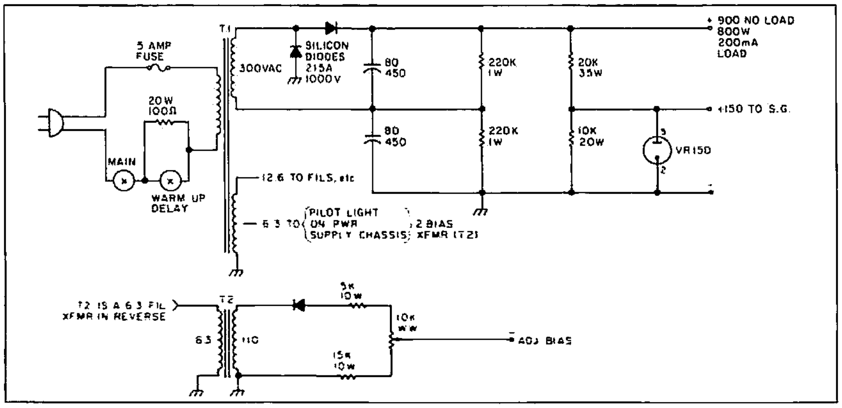

Figure 2. PS for the 29 MHz amplifier.

Deviation Meter Circuit

You can use this circuit in most FM VHF receivers. Hookup is off the FM discriminator. I use a three-wire shielded mike wire and a subminiature stereo jack/plug. The plug tip for B+ is from the radio, center for signal, and shield for ground. This makes for a clean installation. I put this circuit into a small box and attached it to the dash of my car, using Velcro. Every signal transmitted has its own deviation signature. This can be a real plus in jammer hunting. You can obtain most parts at Radio Shack. (See Figure 3.)

Also from N6JSX:

Automatic PTT Switch

This little circuit for T-hunters lets you set your transmitter to turn on automatically at a speci- fic time. The T-hider can vacate the area and even go to the starting point to watch the confusion!

Set the alarm to the time trip point. Push S1 to hold the PTT open and the relay on. Dead power default is PTT closed. The alarm trips and fires the SCR, which shorts out the relay circuit, drops the relay, and removes voltage.

You need a single cell alarm clock, RS 63-716; KL-DPDT, RS 275-215; SCR, RS 276-1067; S1, RS 275-1571; and ¼ W carbon resistors. (See Figure 4.)

Dale R. Kubichek N6JSX
Rowland Heights CA

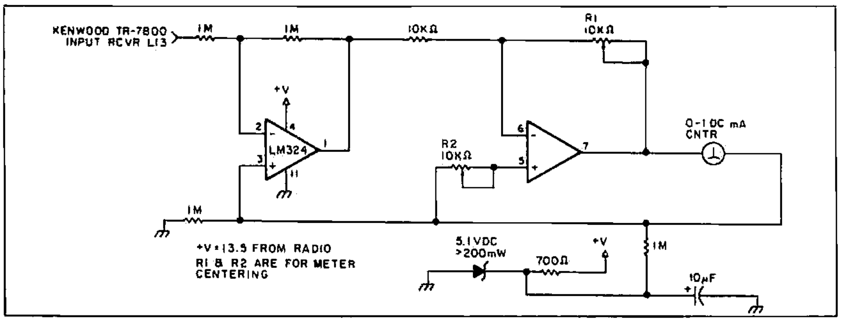

Figure 3. Deviation Meter Circuit.

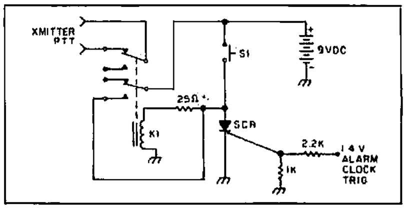

Figure 4. Automatic PTT Switch.

Number 19 on your Feedback card

ASK KABOOM

The Tech Answer Man

Michael Geier KB1UM
7 Simpson Court
S. Burlington VT 05403

Troubleshooting: Finding What Works

I promised way back in my first column to talk about troubleshooting. So here it finally is! Let's get started.

The rig dies and you get out the schematic. One look at all those parts (a lot more than in the "gutless wonder" tube days, eh?) and you head for the shipping box, right? Well, your radio's circuitry doesn't have to be intimidating. It's all a matter of organization.

Ever wonder how anybody designs something as complicated as a modern transceiver? Taken all at once, it just couldn't be done. But any complex circuit can be broken down into sections and subsections, until each one is bite-sized. That's how they're designed, and that's how you should approach them for repair.

Unless the problem is totally obvious, troubleshooting is a process of elimination. The pros find problems very quickly, because they mentally eliminate most of the possibilities before they ever touch the circuit board!

". . . troubleshooting is a process of elimination."

So, first find what works and eliminate it from consideration. Much of this can be discerned without even opening the rig. Does it light up? Does the frequency display seem to work? If so, the power supply and digital circuits are probably OK. If the receiver is dead, is there any hiss at all coming from the speaker? Put your ear up close and listen. If so, the audio amp should be fine. Turn the volume up and down. If the hiss changes with it, then the detector works, indicating trouble farther up the receiver chain.

An understanding of the organization of the circuit (the local oscillator feeds the mixer, etc.) is essential. For instance, if the rig lights up but the receiver seems dead and the S-meter is pegged, I look first at the AGC amp. I do this because S-meters are driven by the AGC voltage. Ever notice that the meter pegs when you turn the RF gain control down? You're really artificially boosting the AGC.

Which Bit is Broken?

Last month's column discussed the likelihood of part failures, classified by component type. Let's do the same for the sections of a radio.

Power supply: This is the site of more problems than any other. Why? Because it carries the most current and, therefore, the most stress. Always look here first. Are all output voltages correct? While a regulator failure could cause them to be too high, it is much more likely that they will be either about right or zero. If one is zero, it could be due to supply failure or a short in one of the circuits being fed. Disconnect the load from the supply and see if it comes up. If it doesn't, start working backwards until the open part is found. But remember, it could have been blown by a short somewhere else in the rig. Check the resistance of the load while it is disconnected from the supply. It should never be zero ohms.

Switching circuits: These parts, such as diodes and relays, are typically used for TX/RX control. Are the circuits in question getting inputs and, especially, power?

Oscillators: A dead local oscillator will kill the receiver and/or transmitter. I've seen lots of them go out. Check with a scope or VTVM, if it can sense at the required frequency. Always look at the output of the oscillator, as you can stop it from working if you probe at the active element (crystal, coil, etc.). In a synthesized rig, it may be working, but wildly off frequency, indicating PLL trouble.

Power amps: Both RF and audio. These handle large current, so they are also candidates, due to high stresses. Symptoms should be obvious: the amp is dead or severely distorted. First check for input to the amp. Then make sure there is no muting or, in the case of an RF final, ALC voltages keeping it clamped off.

Then, check for bad parts, especially in the output stages, where the stress is. For audio amps, always check the speaker and connections to it, including the earphone jack, before working on the amp.

Front ends and IF strips: If the receiver is dead or weak, the local oscillators are working, and the S-meter reads zero, gain is missing somewhere. Probably a bad transistor or chip.

"A dead local oscillator will kill the receiver and/or transmitter"

Transmitter intermediate stages: Lack of modulation, distortion, etc. can be caused long before the signal gets to the final amp. Check mike amp, output of balanced modulator (is it there?), and pre-driver stages.

Finally, always remember that sudden changes in performance are **NEVER** caused by misalignment! Somewhere, a part has gone. **DON'T** start turning coils or trimcaps—you will be very sorry later!

Like playing a musical instrument, troubleshooting is a complex skill best learned on the job. The more you do, the better and faster you get!

Let's look at this month's letters:

Dear Kaboom,

My TS-440S has an intermittent rushing noise in receive. When it's there, it reads S-9 on the meter, and blots out everything. When it's not, all is fine. Keying the transmitter for a second sometimes gets rid of it. The noise is there even with no antenna connected. What gives?

Signed,
Rush Job

Dear Rush,

Sounds like TX/RX switching to me. Either a noisy relay or bad diode feeding power to the front end. A poor connection can look like a resistance, causing stages to oscillate due to insufficient bypassing. I'd check relays first. Don't bother with the little bandpass filter relays; they don't switch when you press the key. Look for any that do and clean them. Also, check the solder connections to the board. Relays frequently have cold solder joints because the pins are large and don't get hot enough during the wave-soldering process. The movement of the relays only aggravates the situation. If that doesn't work, look for the oscillating stage (it should be very obvious on a scope) and see where its power comes from. Finally, it could be a problem with the stage itself, such as a flaky transistor or diode.

Dear Kaboom,

My rig is grounded, but I keep getting burned by the mike, especially on 10 and 15 meters. I know I need a shorter ground wire, but there's no way to do it here. Any ideas?

Signed,
Hot Stuff

Dear Hot,

Sure. Try a coaxial ground. Take a piece of coax long enough to reach your ground. If that length is very close to a quarter wavelength of 10 or 15 meters, make it a bit longer. Now, get two 0.1µF ceramic caps, rated to take a few hundred volts, or a kilovolt, if you are using an amp. Connect one cap between the center conductor and the shield on each end of the coax.

Now connect the center conductor to the ground of the rig, and to the ground at the other end. The shield should go only to the caps.

Weatherproof the one on the outside. The RF that attempts to climb back up the shield will be shorted back to the center conductor, and so to ground, through the caps. It sounds weird, but it works! 73

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ABOVE AND BEYOND

VHF and UHF Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
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The Winds of Change

With the winds of March come changes and, in this spirit, I have been asked to carry on in this column for Pete Putman KT2B. I wish to thank him for the fine work that he has done, and I hope that I will live up to his expectations in carrying on for him.

I think that some information about my interests and background in amateur radio is in order. I live in San Diego, about 20 miles from the Mexican border and 12 miles from the Pacific ocean. I have written several articles for *73 Magazine* in the past, all of which have been slanted towards improving operation on our VHF/UHF microwave bands and have covered my trademark "Microwave Building Blocks."

"...made contact over a distance of 495 miles using wideband low-power FM transceivers (on 10 GHz)."

A Life-Long Interest

I feel very strongly about this subject, and I have been interested in our higher frequency bands for quite a long time. Getting started on these bands and various modes of operation, while keeping things in perspective on the home front, was financially difficult at first. After all, this is "only a hobby," but the desire lingered for an interminable amount of time without fulfillment.

In the '50s and '60s, I converted available military radio equipment, such as the beloved four-channel ARC-4s and ARC-5 VHF radios, to 2 meters for AM operation. Since most of the radios were not complete, I had to construct the other equipment I needed. From this, I guess, grew the seed of my passion for modifying and constructing electronic equipment. It is fulfilling to continue to home-brew some of my gear to complement my commercial equipment.

Though I am not totally home-brew oriented, I do enjoy enhancing my quality commercial equipment, such as my 2 and 6 meter transceivers, with auxiliary equipment. As state-of-the-art circuits have become available, I have become more involved with synthesized, rather than crystal-controlled, equipment. I set up a home lab with the best test equipment I could afford. Much time and effort went into obtaining this equipment, and I had to repair most of the bargain equipment I picked up. That's the price you pay for super bargains.

At the same time, repairing so many different types of equipment was educating. One good lesson it taught me was that without good test equipment, you cannot develop from scratch without paying the price in excessive time spent trying to make something work. Many times I traded my best communications equipment for a special piece of test equipment. But, some of this test equipment is unique and, through several "bargains," I have duplicated the transceiver that I traded for it.

I have been employed by Pacific Bell Telephone for 27 years. Most of my work has been directly involved with microwave radio, data, and video transmission on high capacity systems. In addition, I was also involved with commercial mobile radio systems operating from 30 MHz to 450 MHz. I have, therefore, had my commercial radio license longer than my amateur license. A few years ago, the FCC granted lifetime status to my commercial license.

In this column I hope to provide you with information, ideas, and construction projects. To do this, I'll need for you to inform me of your interests and activities in VHF, microwave, and related subjects. We can create a common ground to exchange ideas and unite amateur groups with similar interests. I would like to see news from UHF microwave groups that I could publish to further our common interests.

Not Just Local Communications

Because of the nature of UHF microwave communications, most people believe they are confined to local communications. True, you cannot make contacts over distances covered by frequencies below 30 MHz, but you can make contacts over quite remarkable distances. For example, during the ARRL 10 GHz contest, Jack N6XQ in Baja California, Mexico, and Gary in Santa Barbara, California, made contact over a distance of 495 miles using wideband, low-power FM transceivers. Through experimentation, Jack discovered a microwave duct that appears to be quite stable. He drove many miles and made many contacts over several months in order to explore and document this duct's properties.

"We are experimenting with using harmonics of 12 GHz to calibrate detectors up on 24 GHz."

In San Diego, we regularly make contacts with hams in the Los Angeles area, more than 100 miles away. On the West Coast, we are blessed with hills and mountains, from which we can make great line-of-sight (LOS) contacts. But mountain tops are not the only place to exploit. Once, the Italians made a 1,000 mile contact over water. I think we can do similar operations over water in other parts of our country. While it's great to have a high hill in your backyard, it's not necessary for microwave operation. I have heard rumblings of trans-lake communications across the Great Lakes towards Canada.

Plans for "Above and Beyond"

With such possibilities, and Jack N6XQ's successful contacts with Mexico, we have much worth exploring. We need to share information, resources, and ideas for experiments. In future articles, I want to cover the difficulties that we have experienced on the West Coast and in other areas, and the solutions we have tried in order to solve each problem and improve our microwave operation.

Also, I plan to provide supportive information on test equipment and transceivers for most microwave bands from 2 GHz up. The main modes of operation will be wideband FM and narrowband SSB, although I may include others, such as amateur television.

All the currently available surplus test equipment I've examined will not operate higher than 18 GHz. Finding test equipment for 24 GHz is a real problem. At present we are working on methods to test equipment for that band. We are experimenting with using harmonics of 12 GHz to calibrate detectors up on 24 GHz. However, because test equipment for the microwave bands is not always easy to acquire, I will offer projects which you can build with a minimum of test equipment. My goal is to also help you construct a workable microwave transceiver with as little monetary outlay as possible. After all, this is supposed to be fun, not expensive.

Next month I will expand on 10 GHz operation and give you some ideas that you can use to get ready for the ARRL 10 GHz contest that is coming up in about five months.

Let me hear from you. What is going on in your area that is related to microwave bands and operation? Do you have a newsletter you could send me? Let me know if I can publish your address, as I believe this would be a great way to put amateurs in touch with each other. Until next month, 73's...de Chuck WB6IGP.

AERIAL VIEW

Antenna News

Arliss N. Thompson W7XU
RR 3, Box 224
Sioux Falls, SD 57106

Troubleshooting

You know the feeling. It's a mixture of disbelief, disappointment and frustration, with a little helplessness tossed in for good measure. It comes when you have spent the better part of the afternoon, or maybe even a few days, working on your latest antenna project. It usually goes something like this:

The sun went down an hour ago and you've just come down off the tower after putting the finishing touches on that new beam. Even though you are tired you run inside to the shack and hook the coax to the rig. Boy, is this going to be great, you think. With this baby, anyone on my frequency within 100 miles that has more that a bobby pin for an antenna is going to have nothing but a puddle of silicon left for a receiver front end. After checking to be sure the frequency is clear, you key the transmitter with a few Watts output, adjusting the sensitivity of your SWR meter for a full-scale reading. You flip the switch to read reflected power, and that's when it hits you. Holy cow! How can that be? The SWR must be 5 to 1! What now?

If you haven't been in a similar situation, you are either new to amateur radio or else you have never erected an antenna more elaborate than a rubber duckie for your hand-held. What separates the men from the boys (or the women from the girls) at this point is how they go about tracking down the cause of their antenna system malfunction.

Start With the Basics

The first thing to do if you find yourself in the above situation is to not panic. Don't, for instance, scramble back up the tower to start changing element lengths as a first step. As with any troubleshooting effort, a systematic approach is generally the best way to go. Bear in mind that when you hear hoofbeats you are more likely to think of horses than zebras. When you begin troubleshooting, rule out the most likely causes of the problem before getting worked up over some complex but highly unlikely source for your difficulties.

Be Realistic

Is there really something wrong with the system, or are your expectations unrealistic? Don't expect the average dipole to give an SWR of less than 2:1 across the entire 80 meter band, for instance. Don't put too much stock in those magazine articles that describe the antenna that is only one third normal size, but gives 8 dB gain and works great off the side, too, and is super for DX and locals both. An antenna system like that is pure fantasy.

Proper Hook-up?

In a similar vein, even with proper expectations, you need to be sure there actually is something wrong with the antenna system. It may seem ridiculous to you as you read this, but more hams than would care to admit have gone off on a wild goose chase searching for a problem that doesn't exist. I'm referring to those of us who at one time or another have found that we had the wrong antenna, or even no antenna, connected to the rig. Others have connected the proper antenna only to see a sky-high SWR that doesn't drop until they finally switch over to the correct frequency band. Of course, neither you nor I have ever done anything so foolish, but simple mistakes do happen and forgetting to check for them can lead to a lot of wasted effort.

Meter Imprecision

It is important to remember that many SWR meters of the "reflectometer" type are quite inaccurate. If you try three of them under otherwise identical conditions, you are apt to get three different SWR readings. So take those readings with a grain of salt. So, first calibrate your "reflectometer" SWR meter. When connected to a dummy load that is matched to the feedline (and the SWR meter), you should see a 1:1 SWR. If not, something is amiss that you should correct before trying to figure out what is wrong with your new antenna.

Check Your Cables!

Faulty coax connectors are one of the most common sources of difficulties in antenna installations, and they are one of the first things to check if problems arise. Poor connections to the shield with nickel-plated PL-259's are a frequent source of headaches for hams. A little care exercised in the assembly of connectors can save a lot of sweat later on. Use your VOM to check for continuity and shorts in the coax while it is on the floor indoors, before antenna erection. And be sure to protect the connectors and coax from the elements with a product like Coaxseal and some electrical tape—water in your coax will ruin it.

Feedline Radiating?

Another thing to check while you are playing with the SWR meter is to see if the SWR changes if you place a short jumper cable between the meter and the antenna. If it does, then any SWR measurements you make will likely be incorrect. The SWR changes you should see with the repositioning of the meter should be a gradual decrease in SWR as you move further from the antenna (this is due to the attenuation inherent to any feedline). The exact values of these changes will be dependent on feedline type and frequency, but they are generally small. Wild swings in SWR with small changes in the feedline indicate that currents are flowing on the outside of the coax, invalidating your SWR readings. The currents may result from an imbalance of current at the antenna feedpoint, or they may be induced to flow on the outside of the feedline braid in cases where the coax comes off at some angle from the antenna other than 90 degrees. The solution may be to place a balun at the antenna or correct some other cause of feeder current imbalance, to dress the feedline so that it runs at right angles from the antenna for as far as possible, or to simply live with the problem. Having balanced feed can be important for maintaining the integrity of a beam's pattern at VHF, but it probably doesn't matter if you have some feedline radiation from your 30-foot high 80-meter dipole. In the latter case, you can disguise (but not actually correct) the problem of a high SWR or difficulty matching by inserting a short length of coax between the transmitter (or transmatch) and the antenna and see how that changes the picture. It's not a very elegant solution, but it frequently works. In some instances, too, improving or modifying the rig's ground system can make a big difference in apparent SWR.

Build it Right?

Let's suppose that you have checked all the obvious possibilities for error or difficulty, and are sure that the problem lies with the antenna itself. There are several things to consider at this point.

First, if you built the antenna from information obtained in a book or magazine article, did you follow the directions exactly? Sure, you can make changes, but some changes are more apt to lead you astray than others. For instance, did you make your beam out of wire instead of aluminum tubing? Or, in the case of VHF and UHF beams, did you use a different size tubing than the one specified? Were the elements in the article tapered while your model used one-piece lengths of tubing for elements? Did you use a conductive boom because it was handy, while the designer of the array used an insulated boom? All of these things can make a substantial difference in antenna dimensions and performance, particularly at the higher frequencies. This is not meant to discourage you from trying your own ideas, or from using what you have on hand, but just be prepared to experience more problems with that route. Unfortunately, with many of these changes, it is very difficult to predict what alterations need to be made to obtain the original's performance, so you are left with cut-and-try methods.

Speaking of following the dimensions published, if you want to achieve equal results with minimal hassle, before you actually get down to cutting aluminum or wire, try to decide if the dimensions given seem reasonable. I received a letter from one ham, for example, who was having difficulty getting a satisfactory match with a small home-brew 2-meter beam. He stated that he had built the antenna exactly as it had been described in the article, and he was even kind enough to send along a copy of the article (a good idea, since I had never seen the article before). I coincidentally had an antenna of similar dimensions and the same matching system, but had had no problems in obtaining a good match. Both antennas used a 1/2-wavelength section of coax connected to serve as a 4:1 balun. The problem was that the formula given in that particular article was incorrect, so when that ham duplicated it exactly, he doomed his project to failure. When I made a balun of the

dimensions described in the article he provided, I couldn't get a good match with my previously functioning antenna, either. The point is to "eyeball" the project before beginning construction to see if the dimensions given seem to make sense. A little experience goes a long way here.

Useful Instruments

Once you have narrowed the problem down to the antenna itself, there are several useful instruments for further defining the problem. One of these is an antenna noise bridge. These are available commercially (Heathkit, Palomar Engineers), or can be home-brewed (described in many *ARRL Handbooks*). The noise bridge allows you to measure the impedance (i.e., both resistance and reactance) of an antenna. These devices contain a wideband noise source and a bridge. When the noise bridge is connected to an antenna and your receiver, you hear the noise generated by the noise bridge. When the bridge controls are properly adjusted there will be a null in the noise heard in the receiver. At that point you can read the antenna's resistance and reactance from the dials on the bridge. If the reactance dial on the noise bridge is already adjusted to zero, you can find the resonant frequency of your antenna by simply tuning your receiver until a null is heard (because the reactance at resonance is, by definition, zero).

One shortcoming of this device is that it measures the impedance at its terminals. If a length of coax is connected between the antenna and the noise bridge, the coax will act as a transformer and hence the noise bridge readings will not necessarily correspond to the conditions at the antenna itself. This can be avoided by using a multiple of ½ wavelength of feedline or otherwise taking the feedline length into account. Another exception is when the antenna is to be matched to the characteristic impedance of the transmission line. While these limitations may seem to be a bit of a nuisance, the noise bridge can be very useful in determining whether your antenna is too long or too short, and can even provide you with an estimate of how much change is needed to move the point of resonance to the desired frequency.

A useful instrument with which many hams are familiar is the grid dip meter. In this era of solid state electronics, its name is a misnomer, but its use is the same. By watching for a dip in the instrument's meter, you can determine the resonant frequency of a circuit. This makes it useful for resonating traps, adjusting the length of mobile antennas to resonance, etc. It is not as flexible as the noise bridge, however, since it shows only the resonant frequency and gives no indication of the actual impedance at a given frequency.

Last but not least—the ohmmeter. An obvious use for it is checking the continuity of connections and connectors. A VOM used in conjunction with a noise bridge and/or grid dip meter should be sufficient instrumentation to troubleshoot the problems with antenna systems most of us are apt to encounter.

Other Trouble Sources

One thing that can be a major problem that many of us can often do little about is the antenna's environment. The antenna's height above ground and its proximity to other objects (trees, guy wires, telephone lines, and even other antennas) can exert a major influence on an antenna's performance. In some instances, this influence may appear to be for the good, such as when resistive losses become high and overwhelm the reactive components at the feedpoint, thereby producing an antenna that is broadbanded but, perhaps unbeknownst to you, lossy. In this case the adage of placing your antennas high and in the clear is sound advice. If you have to erect your antenna in close proximity to other objects, however, you're on your own in optimizing its performance. Each setting is different, and what works in one situation won't necessarily work in another.

Be Systematic

Those are some general suggestions for troubleshooting. It is difficult to be specific without specific cases, but having a systematic approach when troubleshooting is probably your best weapon against Murphy. The general philosophy is quite similar to that taken when troubleshooting a problem with your rig, or even with the family car. In other words, don't jump to conclusions or assume that the worst has happened (it usually hasn't). Instead, start with the most obvious sources of error and difficulty, and work from there.

Good luck! 73

Number 24 on your Feedback card

ATV

Ham Television

Mike Stone WB0QCD
PO Box H
Lowden IA 52255

Satellite Weather Radar and ATV Relays

Weather Radar TV picture images are very colorful, informative displays that can be seen during local commercial TV broadcasts every day on your favorite station. They are commonplace and we now take them for granted. Stations are always competing with each other lor the most attention-grabbing displays. Even Doppler systems are becoming popular in most areas of the United States.

The problem with commercial broadcasts of weather radar images is that they are not always instantly available, especially during inclement conditions. Amateur TV interfaces with these signals to allow ham-TVers "at will" reception. There are nearly 30 such weather radar interlaces out of 126 known ATV repeater systems in the country. This month's column discusses how to obtain access to these signals and interface with Fast and Slow Scan TV, and gives some information about weather radar signals and systems in general.

Captured Images

The National Weather Service (NWS) has a fleet of weather satellites in operation that take photographs of the Earth's weather from space and transmit these images down to ground receiver stations. These ground stations then broadcast the captured images via FAX on HF and VHF frequencies. Many of you now receive these WEFAX images on shortwave receivers with your computer software programs. One of the most popular of these programs is called COCOFAX (originally called WEFAX) for the Radio Shack TRS-80 Color Computer, written by Martin Goodman (send SASE for details). There are a number of other WEFAX programs available for the Commodore C64/128, Apple, Atari and IBM-compatible computers (see Ralph Taggart's columns in back issues of *73 Magazine*).

NWS RADAR LOCATION	RADARS IN VIEW	NWS RADAR LOCATION	RADARS IN VIEW	NWS RADAR LOCATION	RADARS IN VIEW
Abilene, TX	10	Fargo, ND	6	New York City, NY	9
Akron, OH	12	Fort Smith, AR	8	Norfolk, NE	11
Albany, NY	9	Fort Wayne, IN	15	North Platte, NE	11
Alliance, NE	6	Galveston, TX	9	Oklahoma City, OK	11
Alpena, MI	6	Garden City, KS	9	Omaha, NE	11
Amarillo, TX	7	Grand Island, NE	11	Paducah, KY	12
Apalachicola, FL	10	Goodland, KS	6	Patuxent River, MD	7
Athens, GA	14	Harrisburg, PA	11	Pensacola, FL	11
Atlanta, GA	15	Hartford, CT	8	Phoenix, AZ	2
Atlantic City, NJ	7	Hondo, TX	8	Pittsburg, PA	12
Augusta, GA	11	Houghton Lake, MI	9	Portland, ME	8
Austin, TX	10	Huntsville, AL	13	Portland, OR	0
Baton Rouge, LA	10	Huron, SD	6	Raleigh, NC	11
Beckley, WV	12	Indianapolis, IN	14	Rapid City, SD	4
Billings, MT	1	Jackson, KY	13	Rochester, MN	11
Binghamton, NY	10	Jackson, MS	13	Sacramento, CA	0
Bismarck, ND	5	Kansas City, MO	13	San Angelo, TX	9
Bristol, TN	13	Key West, FL	3	San Juan, PR	0
Brownsville, TX	2	Lake Charles, LA	7	Savannah, GA	12
Buffalo, NY	7	Las Vegas, NV	2	Shreveport, LA	11
Burlington, VT	6	Limon, CO	5	Sioux Falls, SD	12
Cape Hatteras, NC	4	Little Rock, AR	10	Slidell, LA	8
Centreville, AL	15	Longview, TX	11	South Bend, IN	14
Charleston, SC	9	Los Angeles, CA	1	Springfield, IL	13
Charleston, WV	10	Louisville, KY	15	Stephenville, TX	13
Charlotte, NC	14	Lubbock, TX	6	St Louis, MO	12
Chatham, MA	8	Macon, GA	14	Tampa, FL	5
Chattanooga, TN	17	Madison, WI	12	Topeka, KS	10
Cheyenne, WY	8	Marquette, MI	5	Tucson, AZ	1
Cincinnati, OH	17	Marseilles, IL	16	Tupelo, MS	0
Cleveland, OH	13	Memphis, TN	12	Tulsa, OK	10
Columbia, MO	11	Meridian, MS	13	Victoria, TX	8
Columbia, SC	10	Miami, FL	3	Volens, VA	11
Columbus, GA	16	Midland, TX	6	Waco, TX	10
Columbus, OH	16	Minneapolis, MN	6	Waterloo, IA	11
Concordia, KS	12	Missoula, MT	0	Waycross, GA	10
Corpus Christi, TX	5	Mobile, AL	10	West Palm Beach, FL	4
Daytona Beach, FL	4	Moline, IL	13	Wichita, KS	10
Des Moines, IA	15	Monett, MO	12	Wichita Falls, TX	10
Detroit, MI	12	Montgomery, AL	14	Williston, ND	1
Duluth, MN	6	Muskegon, MI	12	Wilmington, NC	7
Erie, PA	10	Nashville, TN	12	Worcester, MA	8
Evansville, IN	11	Neenah, WI	12		

Table 1. Numbers of radars in view of each NWS radar.

"Radar has been used to detect precipitation since the early 1950s. . ."

Popularization of the Weather Signal Image

Radar has been used to detect precipitation since the early 1950s, when radar equipment that had been developed during World War II became commercially available. Radar signals now supply valuable weather information to a wide spectrum of government and private users. Advancements in packaged weather radar signal-to-computer enhanced displays, by commercial companies such as Kavorus, Alden, and others, have given the commercial TV industry a boost in colorful weather newstime presentations. Permission **MUST** be obtained from both the sponsoring TV or radio station and the manufacturing company or its representative before any amateur TV feed can be aired.

NWS Weather Radar Systems

The NWS operates a U.S. network of 128 weather radars (see Figure 1). Nearly all these systems feed the weather radar display images over costly and dedicated phone line circuits. Many TV stations now have "dial-up" outside the local area coverage viewing capabilities. This means the user can take a look at other areas' radar displays across the nation at will. An extensive article about these types of systems, written by Raymond Durand, ran in the August 1988 issue of *Broadcast Engineering*.

Smaller, low-power marine and aviation radars operating at X-band (8,500 MHz to 10,680 MHz) are particularly sensitive to attenuation. The powerful NWS 250 kW to 500 kW C-band (5,250 MHz to 5,925 MHz) and S-band (2,300 MHz to 2,500 MHz and 2,700 MHz to 3,700 MHz) transmitters offer significantly better performances. GOES VHF satellite operation in the 1600 and 137 MHz regions also provide beautiful

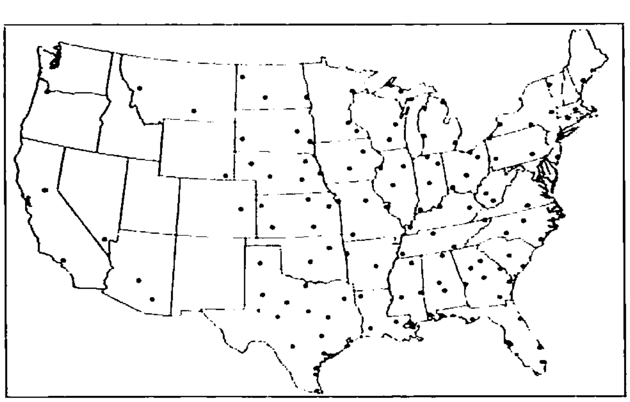


Figure 1. Locations of the NWS radar sites. NWS has allowed direct access by telephone lines to all 128 of its weather radars.

high-resolution direct images. U.S. Navy NAM broadcasts out of Norfolk, VA on 8.080, 8.027, 10.865, 3.357, 16.410, as well as NPM's Hawaiian 14.822.6 MHz broadcasts, are good places to "tune-in" and pick up WEFAX signals.

Interfacing to ATV

How to get permission for the feed? First go to the TV station that has the radar signal and explain to them the public service benefit of obtaining a feed from them. Get cooperation and a written agreement from both the TV station and the manufacturer and/or distributor of the weather radar equipment. You can reach Kavorus, Inc. at the Federal Aviation Building, 6301 34th Avenue South, Minneapolis, MN, 55450. Their telephone number is (612) 726-9515. I suggest you write rather than call. Use club letterhead stationery. Include a basic block diagram of tap feed interfacing, permission obtained from the local TV station (include a copy of the written agreement) and, most importantly, a statement that the general public will not have access to this feed under any circumstances. Don't forget to stress the public service aim.

Next, find out from the station engineer how to obtain a video tap. Set up an ATV transmitter at the TV site (if no QRM problems exist) or run a link feed from the TV station over to your ATV repeater system's input. 910 MHz seems to be catching on for WX radar TV feeds. PC Electronics of Arcadia, California, and Wyman Research of Waldron, Indiana provide transmitters for such feeds. Paulsen Associates and Bill Olson Electronics provide 910 MHz amplifiers. My January 1989 column discussed how weather radar TV images can be used over ATV and packet radio, and also discussed the use of AX.25 transmitted local county coverage maps.

"The National Weather Service has a fleet of weather satellites in operation that take photographs of the Earth's weather from space . . ."

Severe Weather Season Approaches!

As we approach spring, such an on-line system will become very useful. An Earwarn-type established group, as described in my January 1989 column, greatly benefits many Amateur and governmental agencies. Such weather radar feeds are not all that complicated to build or interface, and should be an important part of the ATV club or group purpose for the organization. ATV clubs and groups will gain a lot of new members who will at first want to "see" the captured weather radar images, and then later get genuinely interested in the Ham-TV mode itself. Tuning in the WEFAX signals off of a VHF satellite is a challenging and rewarding portion of the Amateur hobby in itself!

Dayton ATV Workshop Sessions

Just a reminder that we will be once again hosting ATVers Workshop Sessions on Friday and Saturday nights this year at the Dayton Hamvention. They will be held at the Ramada Inn North, just off of I-75 and I-70 at the Little York Road exit. We have a number of guest speakers and topics of discussion, plus live and videotaped displays. These sessions have been very well attended in the past few years. It is a great place to meet other Ham-TVers from all across the country! Arrive early and stay late for hours of relaxing, educational entertainment.

Let Us Know

If you have been enjoying these ATV columns for the past 18 months, please drop a card or letter to *73 Magazine* to let us know. Always fill out the Feedback cards when they are provided in the magazine. See you next month!

QTH-DX

Number 25 on your Feedback card

QTH Ireland

Leon Fletcher N6HYK
274 Webster Drive
Ben Lomond, CA 95005

Ireland

"The Irish have made conversation an art form and the pursuit of it a national pastime," claims the Irish Tourist Board in the opening paragraph of the 32-page brochure they send to all who ask for travel information.

The love of conversation would seem to make hamming an ideal channel for the Irish, yet there are only 2,955 hams in Ireland, or one for every 1,757 residents. On a per-person basis, that's less than one-third as many hams as the US.

Those figures are based on Ireland the island. It is 300 miles long, 150 miles wide, and covers 32,600 square miles, a bit smaller than the state of Maine. Its population of 5,192,000 is slightly more than the population of Wisconsin.

The Irish Tourist Board and many travel books generally consider Ireland as a single unit, but the locals certainly don't look at their lands that way. In 1920 the British Parliament divided Ireland. Northern Ireland chose to remain a part of Great Britain, while the south became the independent Irish Republic.

There's been fighting ever since. The snipings, bombings, and murders have of course become well-known through almost daily reports in our news media. Still, many people are surprised at the number of people killed—2,667—since 1969, when Britain sent soldiers into Northern Ireland to calm the fighting.

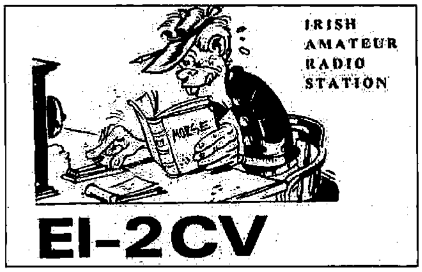
Forty Shades of Green

In Fodor's *Ireland*, the popular travel book, the look-the-other-way attitude of much of the outside world is represented in this line: "Come here (to Northern Ireland) and you'll find thoughts of violence vanishing in the face of its outstanding natural beauty and the genuine open hospitality of its inhabitants."

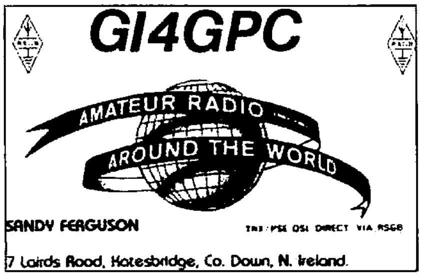
Northern Ireland has 1,568,000 people, about the same as Nebraska; at 5,463 square miles, it is a bit larger than Connecticut. The Irish Republic has a population of 3,624,000, about the same as Kentucky; it covers 27,137 square miles, about the size of West Virginia.

DXers, of course, know that the two Irelands are different, working EI in the Irish Republic, where there are 1,560 hams, and GI in Northern Ireland, which has 2,395 hams. Thus, on a per-resident basis, the less populated Northern Ireland has more than twice as many hams as the Irish Republic.

Despite the fighting, Ireland continues to draw tourists with its diverse attractions. There are more than 200 golf courses, and 28 horse-racing courses. The scenery has "40 shades of green," the Irish Tourist Board claims, adding in language typical of promotional writing that "the landscape is an ever-changing canvas of color and hue." You can see Irish history back to 5,000 B.C., visiting ancient burial sites and centuries-old memorials. There are seventeen museums and galleries in Dublin alone.



If you're of Irish extraction, you can trace your own history, as Presidents Kennedy and Reagan did, by visiting your homestead and looking up living relatives. You can visit the Gaeltacht, areas where Irish is spoken and the residents continue centuries-old styles of social and cultural traditions. You can shop for Irish products, such as sparkling crystal, soft woolens, luxurious tweeds, fine linens, and handmade pottery.



Guests of the Countess and the Earl

Accommodations are especially attractive. You can stay in very comfortable bed-and-breakfasts for about $14 per person per night. Or you can live like royalty and stay at the Birr Castle, for example, for around $300 a night per person, which includes pre-dinner cocktail, dinner with wine, and a full breakfast.

> **"Ireland continues to draw tourists with its diverse attractions."**

The Birr is one of Ireland's more than two dozen private castles which accept guests. It was built in the 17th century, and lies on a 100-acre spread with more than 1,000 trees from around the world. The castle is home for Bredan, the Seventh Earl of Rosse, and his wife Alison, Countess of Rosse, who (for a price) "entertain small groups of recommended visitors at elaborate luncheons and dinners."

The Horse-Drawn Caravan

You can travel within Ireland by all the usual means. Railroads are clean, modern, and efficient, and buses serve virtually all of even the smallest villages. Of course, renting a car is most popular.

Then there's the only-in-Ireland method of travel: horse-drawn caravan. It's a covered wagon with bunks for four people, usually with a kitchen, and storage, especially for the oats and hay for the horse. The caravans don't have a toilet. You're supposed to rely on facilities at the homes of friendly farmers along the way. You travel only five miles a day, "three to four horse hours per day," as one handout puts it. That gives you time to appreciate the countryside, to see places and things you would not have otherwise noticed, time to meet people who stop and chat and exchange views on this, that, and the other thing.

"The Dublin Millennium," a celebration of the 1,000th birthday of the capital of the Irish Republic, occurred in 1987. To honor that occasion, 1,000 events were presented. Illustrating the diversity of the celebration, on November 19 our West Point Academy and our Boston College played American football in Dublin. This was only the second major intercollegiate game with America outside the United States.

Sayings and Legends

One of the major fascinations in visiting Ireland is listening to the colorful Irish sayings: "You've been to an Irish wedding" means you've got a black eye. "Have some Irish apricots" refers to potatoes. "You're getting your Irish up" means you're getting angry. "Irish bull" describes statements which seem to make sense, but actually don't, such as: "It was hereditary in his family to have no children."

Legends are almost a major industry in Ireland. One of the most widely known is the story that snakes cannot live in Ireland, that they die even if brought close to the island. The truth is that there are no snakes *native* to Ireland. But that's not distinctive: There are also no snakes native to Hawaii, Iceland, and many other islands. Still, there are snakes in Ireland now and then, brought in by locals or tourists, some apparently trying to rewrite history.

But it is the legend of Ireland's "Blarney Stone" which should be most powerful in attracting hams, especially rag-chewers. You remember the story—kiss that stone and you'll become skilled in "the gift of gab."

Number 26 on your Feedback card

QRP

Low Power Operation

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

This month we'll look at some letters from the mailbag. We'll also take a quick look at some homemade gear. We build a lot of radio gear—one point that separates us from the majority.

QRP Equipment

Perhaps the most common questions are: "I want to start operating QRP. How do I get involved? Should I buy commercial or home-brew?" Often times our readers are disappointed because the performance (power out aside) of some commercial QRP gear really falls short of that of most 100-watt out rigs. Remember that running QRP means operating at low RF power levels. Even if you have a rig that puts out a max of 100 Watts, if you can crank the RF power level down to 10 Watts out or less, that rig can be a QRP rig!

Somewhere down the road, QRP got a bad rap for inferior gear. Because of the low power levels, many circuits are simple, but simple circuits do not imply inferior design.

Useful QRP Info Sources

Dennis NE4O asks for sources of information on QRP operation. Well, Dennis, you hold in your hands a great source of QRP construction, building, and operation. Hams really do build, and they're always looking for simple construction projects, which you'll find here, in *73 Magazine*.

Aside from this column, there are three more sources for the QRP addict. The largest journal for the QRPer is the *QRP Quarterly*. New members can join for $10 US and $12 DX. Once you've joined, you're a member for life (unless you drop out of sight for a while; then you can renew your membership for the same price). You'll receive a QRP ARCI number, which will be useful during the many contests the club sponsors. Considering the wealth of information you'll receive, membership is a great value. Write to *Bill Harding K4AHK, 10923 Carters Oak Way, Burke, VA 22015.*

Have you ever enjoyed something just because it is simple, with clean logic? If so, you'll fall for the Michigan QRP club and *The Five Watter. The Five Watter* is published by the Michigan QRP Club in March, June, September, and December. It serves as an informative newsletter to its members. The products, projects, features, and fantasies described are solely for the delight of the readers. In short, you just can't help enjoying every minute you spend reading *TFW*. Dues will set you back $7 the first year. After that, dues are $5 a year. Now that's cheap, considering the postage increase last year. Drop a line to *Tom Root WB8UUJ, 538 Leland Street, Flushing, MI 48433* for more information about the club. Tell him you read about it here.

Let's not forget SPRAT from the G-QRP club. A delight for the builder. Chock full of projects. Since I don't know how to convert English pounds to dollars, I'll stick my neck out a bit on this one. Dues have increased, but because of the value of the Sterling against the US dollar, they have been able to retain the $10 rate for overseas members. However, because of the charge during bank conversion to Sterling, make your check for $12 and send it to *George Dobbs G3RJV, 498 Manchester Road, Rochdale, Lance, ENGLAND OL11 3HE.*

Those of you who have been following this column for the past few years will notice that I've mentioned these sources several times before. I continue to receive requests for clubs and newsletters for the QRP operator.

220 Volt Power Supply

Let's reach in and pull out another letter from the mailbag. Al W6JHO writes asking for 220 volt power supplies for the Ten-Tec Century 22. Al will be going overseas, and the only source of commercial power will be 220 volt AC.

Ten-Tec makes a 220 volt AC version of the power supply for the Century 22. Of course, you can always brew one up yourself, or purchase a third-party power supply.

Now, I have a question for you. I remember reading somewhere about a modification for the Ten-Tec Century 21. This mod would allow you to operate the radio from an external 12 volt source. For the life of me, I can't place where I

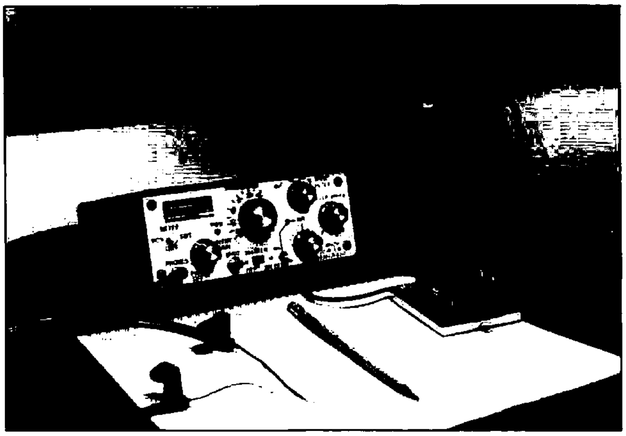


Photo A. Pete Hoover's version of the travel radio. Notice the gell cell batteries and the novel key paddles.

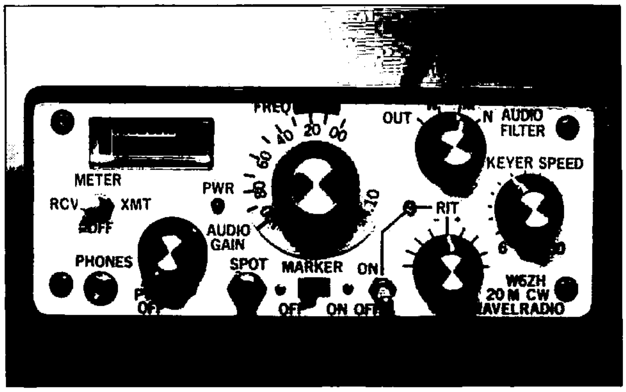


Photo B. Closeup of the front panel of the travel radio. The travel radio was designed by K1BQT.

read that. Does anyone know what I'm talking about, or have a copy of the modification? Sure would be nice to have it in my files. Seems every year around Field Day, I get a dozen requests for such a modification to the Century 21.

The "Super Argonaut"

Rumors, rumors, and more rumors. For the past few years, rumors have been flying about that Ten-Tec will come out with a "Super Argonaut." Last year at the Dayton Hamvention, I talked with Sid Kitrell, vice president of marketing for Ten-Tec. Basically, they would like to come out with something super, but the engineering costs would be difficult to recover. In short, there are not enough QRPers that will drop a kilobuck on a 5 Watt radio. That killed the rumors for a while, but they soon returned. This time, Ten-Tec would make a few hundred Argonaut 515s. I called Ten-Tec. No run of the 515 was planned. Back to waiting and hoping.

Now I hear that Ten-Tec will introduce a new QRP radio at Dayton this year. Again, let me caution you. I don't have a firm yes or no from Ten-Tec on this. My source tells me that the new radio will be a low-powered version of the Paragon, with a retail price of about $1,000. Receiver performance will be number one on the list of priorities. Other features include Phase Locked Loop signal conversion, combined with an analog VFO, digital read-out, a host of filters, and most of the extras of the imported radios. I can't wait for April!

Two-Fer 10 Meters

Moving down to the other end of the price list, has anyone put a Two-Fer on 10 meters? With 10 getting hot, I've had many requests for such information. I've never tried to get the Two-Fer on 10, but I know it could be done with a bit of work. To convert the Two-Fer, the oscillator would have to be changed. The output filters, of course, would have to be changed for 10 meters. Would anyone like to give it a try, and then share your results with us?

Dayton Hamvention '89

The Dayton Hamvention '89 is upon us. For the past few years, I've given some details on hous-

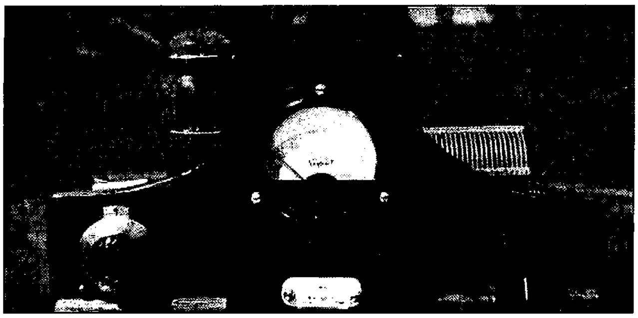


Photo C. The 6L6 Special strikes again! Just when you thought it was safe to go back to transistors. This version was built by Dennis Zona K1VSG.

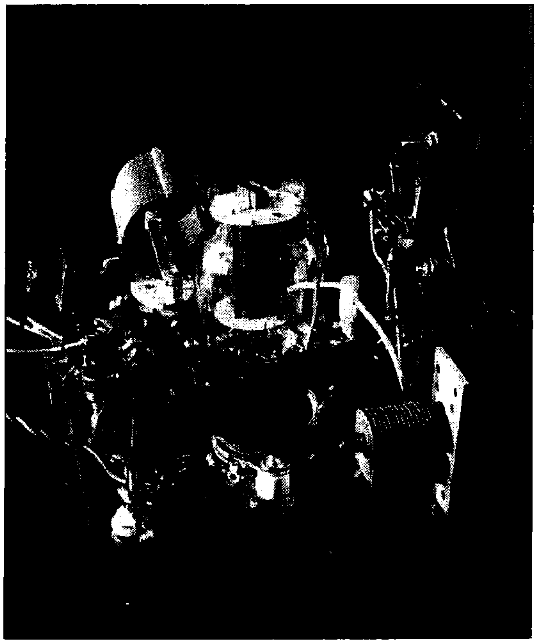


Photo D. Rear view of the special. Notice the copper "ground" on the wood frame. Nice job, Dennis.

ing and events. This year, I was not able to get hard info for this by the time I had to have this column in to editorial. I must assume that housing will be the same as last year. Look up the QRP column from last March. With a bit of luck, there will be no trouble. I do know that we will be having a QRP forum, dinner, and a super good time at Dayton this year. If you have been there before, you know what I mean.

Special Projects

Last May 1987, I did the 6L6 Special. That project sure did a lot for the builders out there. One of the best-looking Specials came from Dennis Zonia K1VSG. Dennis built it as a ham might have in 1938, using a wood "chassis" lined with copper flashing for a common ground. Dennis writes that without the help of his ham friends, the project may not have been done. Many of the parts came from attics, cellars, and junk boxes from all over. That same pride and satisfaction derived after each 5 watt QSO means the same in 1989 as it did in 1939 a half century ago.

On a more modern note, Peter Hoover III W6ZH sent me his version of the K1BQT "travel radio," designed for the 20 meter band. Pete is having a hard time logging all the DX he has been working. This is a fine example of craftsmanship on Pete's part.

It's Your Column

If you would like to have your handiwork spotlighted, just send it to me and I'll do the rest. Remember, this is your column. I can always use photos. Black and white photos are best. Sorry, no instant photos, they just don't reproduce well.

Next month we'll look at power amplifiers and how to tame them. With the upswing in sunspots, ham radio is cooking, and QRP is the microwave oven!

Keyword Index Issue #342

LETTERS

Number 29 on your Feedback card

From the Hamshack

220 Protest

UPS wants 220. UPS is in competition with the United States Postal Service. USPS is "owned" by the same guys who own the FCC. Maybe the FCC gave 220 to UPS so they could not be charged with trying to corner the market.

Don't use UPS. Tell your favorite mail order ham store to send it by snail before using UPS. I believe this is called a boycott.

Robert Godlewski KA4SBE
Ft. Lewis WA 98433

Bob, I can't tell whether you're joking or not. Do you really believe the government fears being charged with "cornering the market" on handling and delivering post? Most people sense that USPS doesn't have as strong a motivation to go after more market share as the private-sector delivery businesses—Uncle Sam assures its existence.

You are absolutely on the money, however, in fighting the reallocation! Hamdom was treated most unfairly here. The issue has many factors, but one thing comes up through the mud—the FCC had to justify money it threw at R & D in the '70s for a mode called narrowband Amplitude Compandored Single Sideband (ACSSB). There were several companies involved in its research, and UPS laid plans to put it to use. UPS claimed they needed a clear 2 MHz chunk of spectrum, and the FCC allocated it in the most expeditious—not the most just—way possible. There are a number of such underused blocks in the spectrum with similar propagation characteristics—including some already allocated to Land Mobile! It was simply less sticky—so they thought—to take away spectrum from hams rather than from other services, or even to assure a clear chunk on existing Land Mobile allocation.

Bob, I'm with you 100%. We must continue our fight to get the reallocation reversed. But it's also time to look ahead. There are still vast amounts of microwave spectrum allocated to the Amateur Radio Service which, with the increasing commercial radio activity on microwave bands, is becoming ever more valuable and sought-after. Unless we start filling these bands with activity pronto, they'll also become the same issue as 220–222 MHz.

So, Bob, continue the fight—and spend time and energy on getting active on 900 MHz and above. Use'em or lose them!

. . . de NS1B

Discouraged

Why do people get discouraged about ham radio? Because they never get started! I looked into it and read everything in the post library I could get my hands on.

I found out that you have to know how to send and copy Morse Code, and you should have a code oscillator and key. I went to Radio Shack and was overlooked while five other customers were helped. I was asked if I knew what I wanted or if my old man gave me a list.

I had read of how friendly, helpful, and willing hams were, so with high hopes I went looking for one. I found a shop that sold amateur radio equipment. They said, "Honey, bring your old man in this weekend and we'll help him right fast." Then I remember a friend said Heathkit had everything. At that shop they said, "Ham radio is not popular. Computers are in." So where else did I look, living on an army post? I checked the MARS station. There I was told, "No female can learn enough to get a ticket."

I went home to do more research, deciding to teach myself. I built the Heathkit oscillator and key, and it worked. I studied the Heathkit learning module. Then I quit for a while, because of illness and of moving to Germany, and because I have been unable to find a ham who would talk to me or help me. I keep hoping to find a ham who will cheerfully help me. I just now, for the first time in two years, found your publication at our local Stars and Stripes. I hope I've shown you one reason why some of us who would be hams are not.

Deborah Chapman, Housewife
USAMMCE
Box 523
APO NY NY 09138

Deborah, although it's true we have a dose of chauvinistic "Good Ol' Boys," there are more and more hams who have open minds and are generous with their time and knowledge.

There are more and more women coming into the ranks. At Dayton last year I saw as many women with callsigns as those who sullenly followed their OMs around, and I hear more and more women on VHF mobile. Perhaps you've heard of the YL (Young Lady) net that meets daily at 0900 UTC on 14.333 MHz? If you have receive capabilities for this band, you may want to listen in on what these women hams have to say. Chances are they've encountered similar problems, and they may discuss their solutions.

Heathkit, by the way, has come back into the ham market full-steam ahead. If the rep you talked to dismissed your interest in ham radio, get on the phone to Heath HQ in Benton Harbor, Michigan and relate this incident. Any rep driving away potential business will be set straight in a hurry!

So, Deborah, don't let narrow-minded sexist condescension stop you from getting involved in a fascinating hobby. If you're truly interested in becoming a ham, I promise you it won't be long before a ham with the proper attitude will come along to help you.

Feel free to give us a call here if you have any more questions (603-525-4201). Let us know, too, when you get your ticket!

. . . de NS1B

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

It is not too soon to plan a trip to Geneva next October 3–9 for "ITU-COM, the First World Summit for Electronic Media." Sponsored by the International Telecommunication Union (ITU), it will be held at the Geneva Exhibition and Congress Centre (PALEXPO), under the theme: "Towards global information: the Electronic Media Explosion." Distinct from the ITU's TELECOM world exhibitions, ITU-COM will be a series of symposia, with one coming every four years.

The ITU continues to grow (see in the Roundup section, below, under "Italy" and "World"), and further information about it and/or ITU-COM may be requested in French, English, or Spanish, from the Press Service, Public Relations Division, ITU, Place des Nations, CH-1211 Geneva 20, Switzerland.

March calendar of events for OSOs: 1—Heroes Day, Paraguay; 2—Peasants Day, Burma; 3—National Unity Day, Sudan; Independence Day, Morocco (6th for Ghana, 20th for Tunisia, 25th for Greece, 26th for Bangladesh); 6—International Womans Day, USSR; 8—National Day, Syria (10th for Tibet, 12th for Gabon, 13th for Grenada, 31st for Malta); 9—Decoration Day, Liberia; 10—Labor Day, South Korea; 12—Commonwealth Day, Swaziland; 13—Commonwealth Day, Great Britain; 17—St. Pat's Day; 21—Vernal Equinox Day, Japan; 23—Pakistan Day, Pakistan; 26—Easter Sunday; Armed Services Day, Burma; 28—British Evacuation Day, Libya; 29—Youth Day, Taiwan.

Roundup

Italy has signed a "Memorandum of Understanding for the provision of Associate Experts to the development programmes and projects administered through the [International Telecommunication] Union." The signer was His Excellency Mr. Roberto Franceschi, Ambassador and Permanent Representative of Italy to the United Nations and its specialized agencies. The move was additional evidence of Italy's increased involvement with developing countries in order to promote economic, social, and cultural development. Two years ago, Italy contributed US$1 million for the feasibility study of the African Regional Telecommunications Satellite Network (RASCOM). (The Organization for African Unity, the OAU, recently made a US$200,000 contribution toward financing this study.)

New Zealand. Des Chapman ZL2VR writes that "What must be, according to my information, record 50-MHz E-M-E (moonbounce) contacts took place recently between ZL and the 'States." On September 8th at 1809Z, Graham ZL2BGJ of Waitara on the West Coast of the North Island, had a very successful contact with Jim W6JKV, Los Altos Hills (near San Francisco, California)—a direct distance of 10,000 km. The very next day Graham made an equally successful contact with WA4NJP in Gillsville, northern Georgia (13,000 km) at about the same time of day, although conditions were not quite as good. The WA4 antenna array is not known, but W6 used four 11-element beams in a quad on 15.3m booms, and ZL2BGJ has seven 12-meter towers, and strung between them are six parallelogram rhombics.

Sweden. More DX information to add to last month's report from SM0COP: From *Radio Sweden* Bulletin Nr. 2010: ". . .a conference, organized by shortwave listeners for shortwave listeners, the Swedish DX Parliament is being held June 16–18th, in Morokuiien, a joint territory on the Swedish/Norwegian border. . .jointly hosted by the Swedish DX Federation and Norway's DX Listener's Club. There will be workshops, a receiver exhibition, an auction, and undoubtedly a number of radio representatives on hand. For more information, you can write to: Stig Granfeldt, Signalhornsgatan 100, S-654 71 Karlstad, Sweden."

USSR. Earthquake. As of mid-December, several US network news programs had carried brief items about ham radio operators carrying messages, but with no details or IDs. It was too soon, of course, to expect reports to *73 Amateur Radio*, but we hope they will be coming. (See story about Hurricane Gilbert in last month's 73 International.) Rescue and relief operations reportedly were slow; could amateur radio have been quicker in the face of the utter devastation? Radio networks have been developing rapidly across the USSR—as has television: According to Jonathan Sanders in the November *World Monitor*, 93% of the population, all across the 11 time zones of the USSR, has access to Soviet TV.

A correction for last month's "QSL Tidbits from NT2X" box: Valery Tyulyapin's call is RA9YD only. RA3AR was also listed by mistake. More Tidbits: A Soviet UDXC DX Club has been formed, with about 128 members. Steep membership requirements: 250 confirmed countries for individual stations, 300 for clubs. QSL Manager is Vlad Zhukov RA3YA, at USSR, 241000, Bryansk, PO Box 73. This year he is mailing his own special multicolor QSL card commemorating 1,000 years of Christianity in Russia. Vlad will appreciate IRCs if you write him anything requiring an answer. *** Victor Tkachenko RB7GG is QSL Manager for the rare UA0KK, UA0ZZ, RD6DZ, UJ8XA, EO5BGH, and RV0YF. He will help with the cards only to W/VE stations—all others please send cards either directly to the stations or via the buro. His address: USSR, 325000 Kherson, PO Box 73. *** Serge UA0KBZ (op. at UZ0KWC), says he has over 25,000 QSL Managers' calls and routes, and would like to put his extensive collection to good use. If anyone needs QSL info *on* any call, even going back 20 or more years, write him at: USSR, Magadan region, Cape Schmidt, PO Box 485, 68630. Serge would like to exchange info with anyone who has a similar collection; also, he'd like to know if anyone has the DX logs of the late W2CTN. Send IRCs if a reply is requested. [*This is always a good idea!—CCC*]

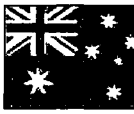
World. The International Telecommunication Union (ITU) continues to grow. The Kingdom of Bhutan has become the 165th member, and the Independent State of Western Samoa has become the 166th member. Bhutan lies in the eastern Himalayan mountains bordered by the People's Republic of China to the north, and India. Thimphu, the capital, is the location of the Department of Telecommunications. The Bhutan Broadcasting Service broadcasts a daily program in English, Sharchopkha, Dzongkha, and Nepali.

Western Samoa (which became wholly independent in 1962 and is separate from American Samoa, whose residents are American citizens) is in the South Pacific. Its capital is Apia, where the Posts and Telecommunications Department is located.

NEW OR CHANGED QSL INFO ON CHINESE STATIONS(*)
(See p.98, April '88 issue)

Station	PO BOX	CITY
BY1BH	1656	Beijing
BY1BJ	6111	Beijing
BY1CKJ	6207	Beijing
BY4AJT	5221	Shanghai
BY4ALC	4043	Shanghai
BY5HZ	604	Hangzhou
BY5NC	1033	Nanchang
BY7HY	14	Yueyang (Hunan)
BY8AC	(**)	Chengdu

(*) From *The JARL News*, Vol.1 No. 4
(**) 38 Guzhongai Street



AUSTRALIA

Following is the third and last part of the report sent in by Jim Joyce VK3YJ, which we have entitled "Four Men and an Island—Weather from Beyond the Outback." Part I appeared in the December, 1988, issue and Part II appeared last month.

Amateurs leave their mark on Willis Island. At least three amateurs can be singled out for special mention. Dave VK9ZD (now VK3DHF), one of the Bureau and Radio Technical Officers, came to Willis Island after only five weeks of home life, following a 12-month tour of duty at Macquarie Island—from one extreme in temperature to the other. (He then went back to the ice with two trips to Heard Island as VK0HI.) Dave's QSL Manager is now his father, VK3EVN. Apart from working DX on all bands and notching up some 3,000 QSLs, Dave also followed the hobby of photography, and many off-duty hours were spent exploring his stations and photographing marine and bird life.

Mike VK9ZG (now VK6AMM) followed Dave, and clearly it was amateur radio that passed the time for him. In less than five months on Willis he had made 8,000 entries in his log, mostly of contacts made on 15 and 20, although around 300 were on 6 meters. He used a TS 120S and 3-el Triband TH3 Jr.

Finally, Tony VK9ZH excelled with 10,000 contacts during his

Mike VK9ZG in the Willis Island shack.

Tony VK9ZH was nicknamed "The Laughing One!"

stay. All his logbook Information has been transferred to his OSL Manager, Bill VK6YL—who has handled that duty for most of the Willis Island amateurs since 1982.

Willis Island duty may not have been intense, but neither was it (nor is it) casual. Every three hours there are such things to be done as noting cloud conditions, temperature, humidity, visibility, rainfall, and wind direction and speed. Every six hours a balloon flight is tracked by radar and observations plotted. And a Radiosonde flight is done every day, usually in the morning.

Old Willis Island hands will be pleased to learn that the chore of "picking disembodied voices out of the ether" on the station's two-way radio link is soon to be a thing of the past. Under a contract with Telecom, a new "silent" service using telephone circuits relayed by AUSSAT satellite will replace the atmospheric crackles and hisses on the old HF radio transceivers now in use to communicate with the parent Regional Offices.

The new service will provide Willis with voice and data access to anywhere in Australia via Telecom's switched-telephone system. It is known as the Iterra Network, using the Aboriginal word meaning "be quick."

The Bureau decided to use Computer-phones linked to a "Commander" telephone-access system at the location, to satisfy a number of diverse needs. The Computer-phone, developed by Telecom, is a small personal computer with a telephone handset which can be used as a telephone, a data transfer/access medium, or as a stand-alone computer in its own right.

Bill Mahoney (Communications Engineering) says the new system will permit data to be logged automatically-directly into the Bureau's Central Message Switching System (CMSS) at the Head Office. This will ensure rapid dissemination of weather observations on both domestic and international communications circuits—*and* cut down on the incidence of errors.

Radio station VL4OX will remain for backup purposes, of course, so there will continue to be a need for a radio operator on the island. We are fortunate that it has been a practice to encourage the Bureau's radio techs to become amateurs. This is one reason why our rarer Australian DX locations are well down on the most-wanted DXCC list.

SOUTH AFRICA

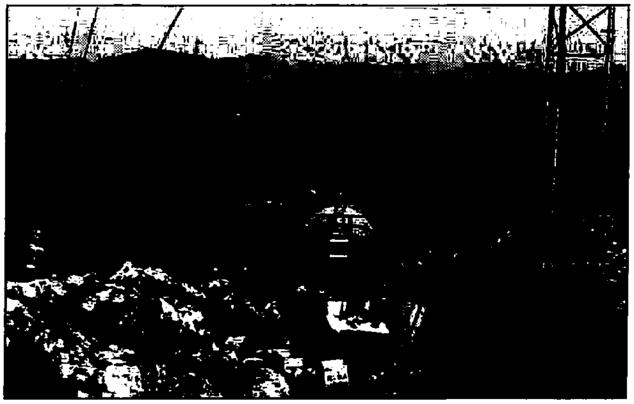
Peter Strauss ZS6ET
PO Box 35461
Northcliff, ZA-2115
Republic of South Africa

Breaking records. A team of South African amateurs broke the Africa record twice for X-band (10-GHz) during 1988. Previously held by the late Gary Howarth ZS6ASO and Dave Woodall ZS6BNT, this 198 km record stood without improvement for many years. Gary Howarth was well known in South Africa for the first 2-meter moon bounce contact and Dave for his leading involvement with the BACAR projects. (BACAR stands for "Balloon Carrying Amateur Radio.") The early records were obtained using wideband i-f until the team of Arnold ZS6KO, Tinus ZS6TL, Julian ZS6AOU, Bill ZS6KO, and Allan ZR6AHL started to use narrow-band modulation. The team was split into two working groups and a path with S9+ signals was made from the site near the South African Broadcasting Corporation transmitter (on the Magalisberg mountains) and a site 211 km away (on the Highlands mountains near Zebediela). That was on August 13, 1988, at 0655Z.

A further attempt by the team over a distance of 252 km with a non-optical pass, due to a 70-meter obstruction, failed on the same day. One of the problems encountered by the team is the lack of suitable long distance sites with non-obstructed paths. Though many sites are available with distances of just around 200 km, access to a suitable site of larger distances is often restricted. In the case of the latest attempt, permission was granted to use a defense force site near the Hoedspruit Air Force base not far from the Kruger National Park.

With satellite TV direct reception virtually unknown, no surplus dishes, receiver modules or i-f strips can be obtained, unless built by the amateurs themselves or imported at great expense. Test equipment in the 10-GHz range is also not easily accessible to the amateurs. These circumstances have held back the development of the 10-GHz band, and only a very few amateurs have tried to make contacts or build equipment.

A bursary for young radio amateurs to study electronics/electrical engineering at a university or technikon in South Africa has been created by the South African Amateur Radio Development



Two views of OM Arnold Mynett ZS6BMS at work. A new Africa 10 GHz record in sight? ZS6BMS is South Africa's IARU VHF WG Coordinator.

Trust. The bursary scheme is intended for first year students in electronics or electrical engineering. Valued at Rand 2500 (about US$1000), the bursary is sponsored by Alcom Systems and will be awarded to suitable applicants entering first years of study. Applicants must be licenced radio amateurs and have a keen interest in electronics.

"We see this as a new challenge for the South African Amateur Radio Development Trust and a major step forward in encouraging young people to take up electronics and radio as a hobby while still at high school," said Professor Pieter Rademeyer, Chairman of the Trust. "We are particularly pleased that Alcom Systems has seen their way clear to sponsor this bursary, as it is important for industry to become involved in the training of manpower."

Although only one bursary is available for 1989, the Trust is involved in fund raising to have more bursaries available in the future.

Three years ago, the South African Amateur Radio Trust was formed to promote amateur radio in South Africa. It was done by a team consisting of amateurs with roots in the SA Radio League. SA AMSAT, the South African Electronics Industry, and South African Universities. "During our short existence, we have already been involved in various student projects at the University of the Witwatersrand (in Johannesburg), University of Pretoria, and Technikon OFS (in Bloemfontein)," Prof. Rademeyer said. "During the past two years we have also sponsored several black students to study for the Radio Amateur Exam (RAE) and were directly involved in the first three Blacks becoming licensed radio amateurs."

JOHANNESBURG BRANCH
South African Radio League

GOLDEN CITY AWARD

The Golden City Award is issued to applicants who have made the specified number of two-way contacts with stations located in the Greater Johannesburg Area (KG43).

DX-Amateurs/SWL 5 contacts
ZS-Amateurs/SWL 20 contacts

The cost of the award is R3.00 ($5.00 or 10 IRC's), which includes airmail costs. Applicants should submit certified logs to the Awards Manager, SARL Johannesburg Branch, P.O. Box 2327, Johannesburg 2000, South Africa.

Endorsements can be applied for i.e. CW, SSB, EME, RTTY, Satellite, SSTV, etc.

TUNE TO THE INTERNATIONAL GOLDEN CITY OX NET ON FRIDAYS AT 14h00 UTC ON 14,180 MHz.

There are no time limits for the Golden City Award.

The South African Amateur Radio Development Trust can be contacted by writing to SAARDT, PO Box 13273, Northmead 1511, South Africa.

Marion Island will be reactivated in April after 10 years of silence, thanks to Peter Sykora ZS6PT who will be traveling there with a meteorological team. He has applied for the callsign ZS8MI (ZS8 is the new prefix for the island). Peter will be a Radio Technician for the 14-month visit and will operate as an amateur when the South African Weather Bureau's communications system is not in official use. He will have HF, 6 meter, and satellite equipment, and access to rhombic antennas.

Updates on the trip will be issued during the Radio RSA's "Amateur Radio Spectrum" program as follows: 1445 UTC to Eastern Europe on 21535 kHz, to Europe and the UK on 21590, to the USA on 25790, and to Africa on 11925 kHz; 1845 UTC to Europe on 15365 and 17795 kHz; and 0245 UTC to the USA and Canada on 9615, 9580, and 11760 kHz.

Further information is available from Nick Moon ZS6BBY and Hans van de Groenendaal, South African Radio League, Johannesburg Branch, PO Box 2327, Johannesburg 2000, South Africa.

Marion Island, access to which is limited now to scientific teams, under a UN treaty, was last heard from in 1977 when Johan Jordaan ZS6BEE operated with the callsign ZS2MI.

Number 31 on your Feedback card

Dx

Hams Around the World

Chod Harris VP2ML
PO Box 4881
Santa Rosa CA 95402

Rotuma Island—The Next DXCC Country?

About 400 miles north of the capital city of the Fiji Islands lies tiny Rotuma Island, which may well be the next addition to the DXCC list as a separate country. The circumstances that may make Rotuma a new DXCC country may also lead to the designation of other new countries in the Pacific.

Rotuma is situated al least 280 miles from any other island in the Fiji group. It is actually closer to the Solomon Islands and Tuvalu than to its parent group. (That 280-mile figure is very important, as we will shortly see.) Rotuma was first spotted by Europeans in 1791, when Captain Edward Edwards discovered it while searching for the mutineers from the *Bounty*. (The mutineers actually settled on Pitcairn Island, almost 4,000 miles to the east.) Rotuma was annexed to the British crown colony of Fiji in 1881, and thus became part of the country of Fiji when Fiji became independent in 1970.

Separate Country Status

The argument for separate DXCC country status for Rotuma hinges on what appeared to be a minor change in wording in the new DXCC rules approved by the ARRL Board of Directors in January 1988. The country criteria rules governing islands were slightly modified, supposedly to make them clearer, and to avoid the controversy surrounding the Alaska DX Club's efforts to have the Pribolofs approved as a separate DXCC country. In modifying the rule, the DX Advisory Committee opened the door for several new countries in the Pacific.

The modified rule 2(a) states that an island situated more than 225 miles from the shore of the parent group of islands is a separate DXCC country, if the parent group of islands is a separate DXCC country by reason of government. The old rule required a 500-mile separation for country status, and didn't differentiate between islands that were countries by virtue of government or by reason

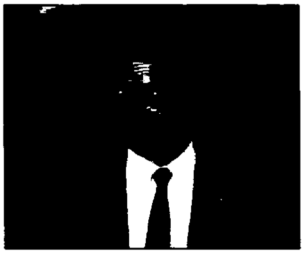


Photo A. Kip Edwards W6SZN, one of the operators of the 3D2XX DXpedition.

of separation from the parent country, such as Hawaii.

This means that if a country is truly independent, any part of that country separated by more than 225 miles of open water can be considered a separate country for DXCC purposes.

Eric Scace K3NA researched Rotuma, and submitted an application for separate country status to the DX Advisory Committee based on his findings. Eric first showed that Fiji was indeed a country by virtue of DXCC Country Criteria Rule 1: a sovereign state by reason of government. Fiji is a member of the United Nations, handles its own diplomatic relations, issues its own currency and stamps, and generally meets all the necessary criteria for an independent state.

Once the status of Fiji as an independent state was established, Eric went on to show that Rotuma was at least 280 miles away from the nearest point of land making up any part of the parent country of Fiji. Through careful study of USA Defense Department charts, backed by mathematical analysis from latitude and longitude, Eric proved that Rotuma was no closer than 285 miles from any part of the main group of islands that comprise the country of Fiji.

The 3D2XX Operation

Based on the modified DXCC country criteria, Rotuma appeared to be an excellent candidate for separate DXCC status. However, no country is added to the DXCC list until an accredited operation takes place from that country. So the next step in adding Rotuma to the DXCC countries list was to get on the air from the remote island.

This turned out to be very difficult, as there are no tourist facilities on the nine-by-three-mile Rotuma, and travel to the island is discouraged. Only relatives of the 3,000 Fijians living on Rotuma can get permission to stay on the island. Eric wrangled an invitation to Rotuma through Ed DeYoung VK8XX, whose wife comes from Rotuma. Ed, who also holds the Fiji callsign 3D2XX, made arrangements for Eric, his friend Toni Zimmer KN3T, and veteran DXpeditioner Kip Edwards W6SZN to travel to Rotuma in October, 1988, and stay for two weeks.

"An island situated more than 225 miles from the shore of the parent group of islands is a separate DXCC country."

The DXpeditioners had to ship all their equipment, antennas, food, and even drinking water ahead by the monthly supply ship, as the plane which flew them into Rotuma had limited cargo space. Since there were no hotels or tourists homes on Rotuma, the DXpeditioners shared the home of their hosts, slept on the floor as the natives do, and ate the local cuisine.

Eric and his fellow travelers made all the necessary arrangements, and on October 22, they fired up as 3D2XX from the potential new DXCC country of Rotuma. The operators had announced ahead of time that they disliked the practice of sending partial calls in the pile-ups; they wanted to hear the entire callsign. They also warned against other time-wasting tactics, such as a calling station sending his callsign more than once, asking when the station would be on another band or mode, or stations calling out of turn. Their warnings seem to have been heeded, as the pile-ups were (reasonably) orderly, and DXers had no trouble making contacts on most bands or modes.

Photo B. Eric Scace K3NA masterminded the Rotuma operation, and wrote the DXAC proposal for separate country status for the island.

The 3D2XX operation netted more than 32,000 QSOs, including more than 8,000 with European DXers, despite the fact that Europe was more than 10,000 miles from Fiji, and the path between them runs straight across the North Pole, always a difficult path for radio contacts. Most of the rest of their contacts were evenly split between stateside and Japanese DXers.

Volunteers from the Northern California DX Foundation, which provided a generous donation to help finance the trip, is handling the QSL cards for the 3D2XX operation. The address for the cards is PO Box 1, Los Altos CA 94023. (Don't use the regular NCDXF address, as it slows the QSL process.)

More DXCC Countries?

Eric Scace's detailed and well-reasoned application for separate DXCC country status for Rotuma is almost certain to be approved by the DX Advisory Committee. But even more interesting for DXers is the precedent set by this: the possibility of still more new countries, based on the modified rule 2(a).

Many islands lie more than 225 miles from their parent DXCC country. Sala-y-Gomez from Easter Island, Malden Island from Kiritimati, Banaba Island from Tawara, the Marquesas from the rest of French Polynesia, Palmerston Atoll from the Cook Islands, and many more. If enterprising DXers can show that the parent DXCC country has separate DXCC status by reason of being an independent country, then islands more than 225 miles away may well qualify as new DXCC countries. Look for more DXpeditions to obscure, out-of-the-way islands in the next few years!

Number 32 on your Feedback card

HOMING IN

Radio Direction Finding

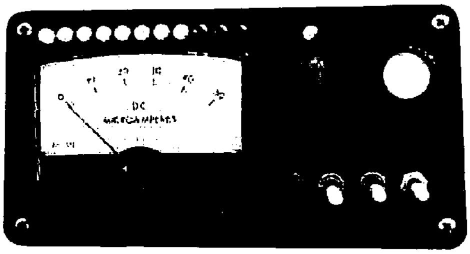


Photo A. WA6DLO's control box contains the attenuator control and read-out in the upper right corner, plus an external S-meter, noise meter, and LED-bar meter.

Joe Moell PE K0OV
PO Box 2508
Fullerton CA 92633

Handling Strong Signals

In the last two columns, you've seen how a beam or quad makes a simple, high performance VHF RDF antenna, and how easily you can put one together. But before you're ready to go out and bring home the trophies, you'll need to do a little more work.

At the start of the hunt, the hider's signal may give your receiver only a fraction of a microvolt, but when you get in close, the receiver could get pounded with nearly a volt of RF, even if the hidden T is running low power. The S-meter circuit on your VHF FM rig doesn't have nearly that much range. It probably reaches full scale at 10 microvolts, giving only about 30 dB from minimum to maximum. That's good because it's easy to see the meter peaks when you swing the antenna, but it's bad because the meter will stay pinned when the signal is strong.

Without some sort of low sensitivity receiving system, you may think you're close to the hidden T when you're actually many miles away. You certainly won't be able to get close enough to the hidden T to identify it. That's where the attenuator comes in. This is a device that goes between the antenna and the receiver to reduce the signal level down to within the range that the receiver and its S-meter can handle.

External Attenuators

Attenuator boxes have been around for a long time and have plenty of uses outside of RDF work. For RDF use, connect it in the coax line between the antenna and the transceiver. You can buy nice commercial ones if you have money to burn, or you can readily make your own with ordinary carbon resistors, toggle switches, and a copper-clad board.[1] Most local hunters here in California use these simple step attenuators. There are caveats here, however. You have to remember to switch all sections off before you transmit. If you forget, you may burn out the resistors and put yourself out of the hunt. Also, very strong signals can go around an external attenuator and enter directly through the receiver case or the coax between attenuator and receiver, pinning the S-meter.

There is another kind of easy-to-build external attenuator that uses sliding pieces of brass tubing. It was described a couple of months ago here in *73 Magazine*, and there is also a version in the T-hunt book.[2] Although it can't get cooked if you build it without any matching resistors inside, transmitting through it could ruin your day because it presents a very bad match to your transmitter at some settings. If the rig's high-VSWR shutdown circuit is working OK, there's no problem. But I'd rather risk some burned up resistors than a burned out final amplifier.

The Internal Solution

If you're not afraid to open up your receiver and do some minor augmentation surgery, you can have the best attenuation scheme. It gives full control over sensitivity and you can transmit safely at any time. As a bonus, you'll get more attenuation range than is possible with an external attenuator, because there's no RF leakage problem.

Vince Stagnaro WA6DLQ, a successful local hunter, designed this internal attenuator system, based on earlier work by Peter Bertini K1JZH, Russ Andrews K6BMG, and others. Vince's design is really "deluxe" because it features a rotary control that is calibrated in 10 dB steps. It's fast and easy to use, and the calibrated read-out will help you estimate your relative distance to the hidden T.

You'll need a copy of your receiver schematic before you start. Attenuation is accomplished by reducing the supply voltage on the early RF stages of the receiver. Mods are made only on the DC portions of the circuit, so receiver alignment is not affected. The only connections between the control box and the receiver are the voltage control lead and ground. When you're not hunting, disconnect the control box, and the receiver will operate at full gain.

Install attenuator control transistor Q1 and associated components R1, C1, and C2 on a very small piece of perf board inside the receiver case. Lift the B+ side lead of resistors that are in series with MOSFET drains of the stages to be controlled and connect to the emitter of Q1, as shown in Figure 1.

Vince built his unit for use with a Kenwood TR-7950 transceiver and found that he got best results by breaking the supply line to the RF preamplifier (R7), first mixer (R15), and first IF amplifier (R21) stages. You'll probably find that controlling the same stages on your own receiver will work well. You should not need to control stages beyond the first IF amplifier.

Drain resistors for RF/IF stages are usually in the range of 22 to 100 ohms. Make sure that they supply B+ to both the FET drain and the gate-2 voltage divider, if used. Recent sets such as the TR-7930/7950 and IC-25 are configured this way. The gate-2 divider current does not pass through the drain resistor on some older rigs such as the TS-700A. On those sets, the top of the gate-2 divider resistor pair must also be connected to the controlled voltage line.

Some receivers are different because they have two RF preamplifiers or a passive mixer. Experiment to see which stages need to be controlled on these units. Do not reduce the supply voltage to local oscillator stages. If you have trouble figuring out your receiver schematic, get a local techie ham to help you. Just give a call on a nearby repeater, and they'll probably come out of the woodwork.

Working in today's tiny transceivers can be a bit cramped. Unless you are skilled in the necessary special techniques,

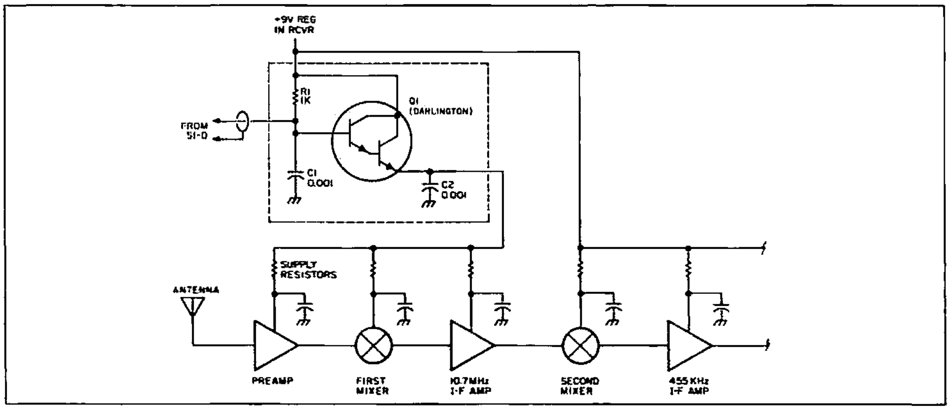


Figure 1. Circuitry in dashed lines is added inside the receiver to control the supply voltage of early stages. Typical stages of modern VHF-FM receivers are shown in block form.

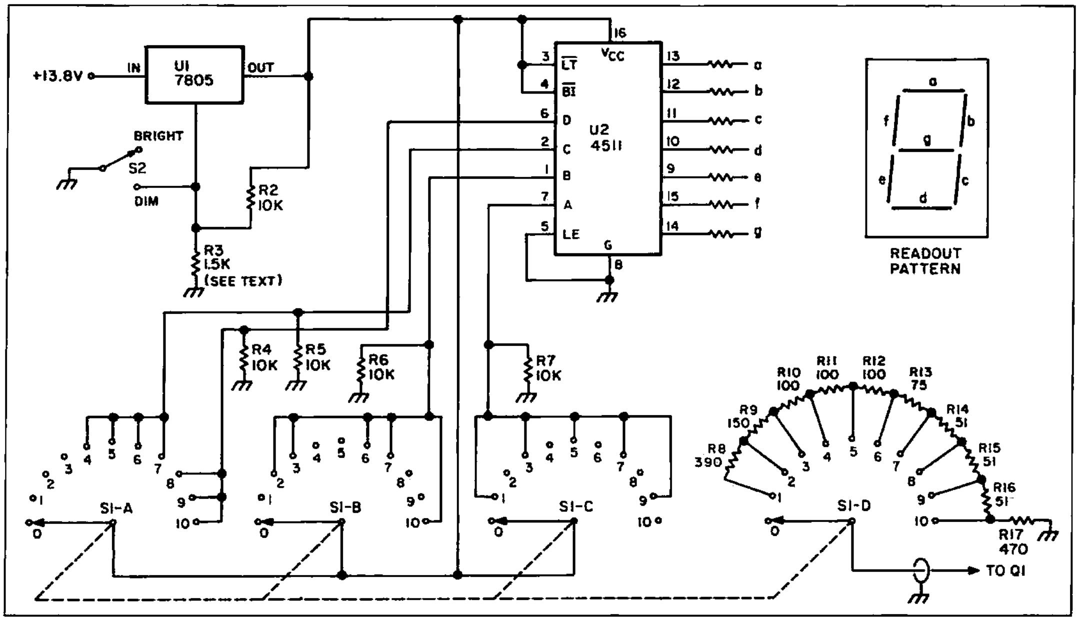


Figure 2. Schematic diagram of the attenuator control unit, which goes in an external box on the dash.

avoid transceivers that use surface-mount components, such as the Kenwood TM-221/321 series and TM-621/721 dual-banders. Remember that the radio will get plenty of shock and vibration in mobile hunting use, so take your time, be neat, and tape all loose wiring carefully to prevent shorts.

Some sets, however, seem to be custom-designed for this kind of modification. The ICOM IC-22U and Clegg FM-DX have one jumper wire that connects B+ voltage to the preamp, first mixer, and first IF stages. Find that jumper and break it, connect the Q1 circuit, and you're in business!

If the hunt rules require closing in on foot, you'll need a field strength meter or a battery-powered, hand-held rig with internal attenuation. You can modify a handie-talkie, but you'll need the hands of a surgeon. A good choice for a rig to modify for this purpose would be one of the older crystal portables, such as the Kenwood TR-2200 or Drake TR-33. They're easy to work on, and you can find inexpensive ones in the used market. Consider deleting the read-out, replacing the rotary switch and fixed resistors with a potentiometer, and mounting the pot inside the rig to make a one-piece, hand-carried "sniffer."

The Control Box

I suggest you build or buy a nice large box (see Photo A) for the attenuator control unit. There are plenty of other T-hunt gadgets, such as a noise meter, remote S-meter, audio S-meter, and DSB detector that you may wish to put inside later. Mount the box firmly to the dash in a position that allows easy reading and viewing, but does not obstruct road vision.

If your transceiver has a multi-pin accessory connector, hooking it to the control box is a snap. Otherwise, drill a hole in the rig to add a connector, or rewire a connector you don't use now, perhaps the external speaker jack. While you're at it, plan ahead and make provisions for wiring in other features you may want to add later, such as the remote S-meter and DSB detector.

All parts in Figure 2 are mounted in the control box. The circuit of S2, R2, and R3 force the output of U1 to be either +12 volts to give bright LED read-out indication for daytime hunts, or +5 volts for dim read-out on hunts at night. Select R3 to give approximately +12.2 volts at U1 output in the BRIGHT position. Power for the control box can come from the cigarette lighter socket.

Rotary switch S1 has eleven positions and four decks, such as Centralab PA1014 (shorting) or PA1015 (non-shorting). Position 0 gives no attenuation (full receiver gain) with the LED read-out blanked. Position 1 gives 10 dB gain reduction and a "1" indication on the read-out, and so on up to position 10, which is 100 dB attenuation and "0" on the read-out.

Q1 is a Motorola MPSA14 Darlington transistor. It's a common part, but if you can't find it, substitute a NTE46 or ECG46 standard replacement transistor. All resistors are quarter-watt parts. The single-digit LED read-out is a common-cathode type, such as Radio Shack 276-077. Values of R8-R17 are for WA6DLQ's TR-7950 installation. If you use a different receiver, try Vince's values first. For the most accurate steps, go through the calibration procedure and determine your own values for R8-R17.

Calibration

To accurately calibrate the internal attenuation system, you'll need a signal generator with variable output on the selected band and an accurate RF attenuator for reference, either built into the signal generator or external. Hook the signal generator through the reference attenuator to the input of your modified receiver. R8-R17 should not be installed at this point. Set the reference attenuator for 100 dB and power up the receiver and attenuator control box.

With the rotary switch on your new internal attenuator set to zero, adjust the signal generator output control for a mid-scale reading on the receiver S-meter. Now set the reference attenuator for 0 dB and turn the rotary switch to position 10 ("0" on the read-out). Select a value for R17 that gives the same mid-scale reading on the receiver S-meter, and solder it in.

Set the external attenuator for 10 dB, turn the rotary switch to position 9 ("9" on the read-out), select a value for R16 that gives the mid-scale S-meter reading, and install it. Next, set the external attenuator for 20 dB, turn the rotary switch to the next position ("8" on the read-out), select a value for R15 that gives the mid-scale S-meter reading, and install. Continue in the same fashion through the rest of the rotary switch positions, ending by selecting R8 to calibrate position 1.

This internal attenuation method works very well with MOSFET or junction-FET RF amplifier stages, used in almost all VHF rigs now being sold. Many older sets use bipolar transistor stages instead of FETs. Voltage reduction doesn't give good results with these rigs, but raising the voltage on the ground side of the transistor emitter resistors usually works well. This technique is described in the T-hunt book.

With your gain antenna, S-metered receiver, and attenuator, you have all the necessities to go hunting on your favorite VHF band. However, there are a number of additional devices that can make you more successful. In the next few months, we'll discuss tricks for antenna polarization selection, antenna mounting, and noise metering. ■

[1] Moell and Curlee, *TRANSMITTER HUNTING–Radio Direction Finding Simplified*, TAB Books #2701, p. 56. Available from Uncle Wayne's Bookstore.

[2] Cloninger, W.C. "Super Simple Attenuator," *73 Magazine*, January 1989, p. 14.

Number 33 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

CAVE CITY KY
MAR 4

The 13th annual Glasgow Swapfest, sponsored by the Mammoth Cave ARC, will be held at the Convention Center from 8 AM until everyone goes home. Admission is $3, tables are $3 each. Forums and an excellent flea market. VE exams will be given with walk-ins welcome. If upgrading, bring original license and a copy. Talk-in on 146.34/.94. Additional information from *N4HCO, 1379 Whites Chapel Road, Glasgow KY 42141.*

HARLINGEN TX
MAR 4–5

The South Texas Amateur Repeater Society is sponsoring its Hamfest at the Casa de Amistad on the above weekend. It will feature FCC and SCT forums, packet demonstration and participation, dealer displays, air-conditioned flea market, VE exams, RACES/ARES meeting, and ARRL forum. Talk-in on 147.99/.39 English; 146.10/.70 Spanish. Admission: advance, $5; door, $6. Tables: advance, $7; door, $10. For registration, contact *Dr. David Woolweaver K5RAV, 2210 S. 77 Sunshine, Harlingen TX 78550. (512) 425-7744.* For VE exams, *Fred Wasielewski, 465 Doherty Ave., San Benito TX 78572. (512) 399-0328.* Flea Market and parking, *Bob Tichenor WD5KBZ, 1522 N. 77 Sunshine, Harlingen TX 78550. (512) 423-6407.*

YORK PA
MAR 5

The Second Annual York Springfest (Ham and Computer) will be at the Dover Firehall. Two floors of indoor tables and free tailgating. Refreshments and prizes. Inside tables, $10. Registration, $4. Unlicensed spouse and under twelve free. VE exams. Parking. General admission 8 AM. Talk-in on 146.37/.97 and 147.93/.33. For advanced information and registration, write or call *York Springfest, PO Box 50, Shrewsbury PA 17361-0050. (301) 239-3878.*

NORTHAMPTON MA
MAR 5

The Mt. Tom Amateur Repeater Association amateur radio and electronics flea market will be held at the Smith Vocational School. Doors will open at 9 AM, with vendor set-up at 7 AM. Admission, $2; under twelve free with adult. Tables, $10 in advance, $12 at door. VEC walk-in exams, check for ARRL VEC for $4.55 and two positive IDs. Talk-in on 146.94, 223.82, and simplex 146.52. For reservations, contact *Bob WB1EQS, (413) 532-6411 days; or Mickey N1CDR, (413)562-1027 evenings.* Or write *MTARA Fleamarket, 6 Laurel Ter., Westfield MA 01085.*

McKEESPORT PA
MAR 5

The Two Rivers Amateur Radio Club is sponsoring its Ham Fest from 8 AM to 3 PM at the Rostraver Fire Hall near Belle Vernon. All indoor tables, dealer area, ample parking, refreshments. Admission is $1 at the door. Full table, $6; half table, $4. Talk-in is on 146.13/.73 WA3PBD/R Repeater. Contact *Louis H. Zimmerman N3GPJ, 911 Roland Road, Wilkins Twp. PA 15221. (412) 351-1562 from 10 AM to 10 PM.*

ST. LOUIS MO
MAR 10

The Jefferson Barracks Amateur Radio Club will hold its 29th annual amateur radio auction at the Concordia Turners Hall. For more information, contact *Cheryl Komor NØGXY, 10400 Meath Drive, St. Louis MO 63123.*

EGG HARBOR CITY NJ
MAR 11

The Shore Points Amateur Radio club invites everyone to its Springfest '89 starting at 9 AM at the Atlantic County 4-H Center. 8000 square feet of heated indoor selling space is available, with outdoor tailgating. Sellers, $5 per space (tables limited); buyers, $3. Talk-in on 146.385/.985 and 146.52 simplex. Write *SPARC, PO Box 142, Absecon NJ 08201.*

INDIANAPOLIS IN
MAR 12

The Indiana Hamfest, sponsored by the Morgan County Repeater Association, will be open to the public at 8 AM at the Indiana State Fairgrounds Pavilion. VEC exams. Admission, $5 at door. Eight-foot tables, $8 each. Advance registration suggested (tables sold out in 1988). Set-up on the 11th from 3–9 PM. Overnight security. Talk-in on 145.25. For table reservations or information, send SASE before February 24 to *Aileen Scales KC9YA, 3142 Market Place, Bloomington IN 47403. (812) 339-4446.*

TRENTON NJ
MAR 12

The Delaware Valley Radio Association will sponsor HAMCOMP '89, their 17th annual flea market of radio and computer equipment from 8 AM to 2 PM at the National Guard 112th Field Artillery Armory. Admission is $3 in advance, $4 at door. Indoor selling spaces are $10 (wall space) or $7; outdoor spaces are $6. Sellers must provide their own tables. Doors open at 6 AM for vendors and 8 AM for the public. Talk-in on 146.07–.67. For information and reservations, write to *HAMCOMP '89, c/o KB2ZY, R.D. 1, Box 259, Stockton NJ 08559. SASE please.*

PISCATAWAY NJ
MAR 18–19

The Piscataway ARC will operate their annual special event station from 0000Z to 2400Z each day to Commemorate the WWII operations of the Voice of America Relay station WRCA, which was located in the Bound Brook section of Piscataway. Members will operate under their own callsign plus /VOA. Suggested frequencies: CW—novice portions of the bands; phone, the lower third of the general portion of the bands on 75, 40, 20, and 15 meters and the novice portion of the 10 meter band. For certificate, send #10 or 9x12 SASE for unfolded certificate, with your QSL to the *KO2K callbook address.*

FT. WALTON BEACH FL
MAR 18–19

The Playground Amateur Radio Club will hold the 19th Annual North Florida HAM/SWAPFEST at the Shrine Fairgrounds. Doors open at 8 AM both days. Flea market, commercial exhibits, ARRL, MARS, and QCWA meetings. Banquet Saturday night. Free parking. RV parking $10 with hookups. Talk-in on 146.79/.52. Admission, $3 advance, $4 at door. Tables, $10 for one day, $15 for both days. For more information, write *PARC, PO Box 873, Ft. Walton Beach FL 32548.*

WEST HARTFORD CT
MAR 19

The Insurance City Repeater Club will hold its annual Computer and Amateur Radio Flea Market at the American School for the Deaf. Doors open from 9 AM to 2 PM. Admission is $2. Tables are $10 each. Talk-in on 146.28/.88. Contact *Chuck Motes K1DFS, 22 Woodside Lane, Plainville CT 06062.* Please register early. Tables usually sold out in advance.

MAUMEE OH
MAR 19

The 34th Hamfest/Computer Fair sponsored by the Toledo Mobile Radio Association will be indoors at the Lucas County Recreation Center. Dealer setup 5–9 PM Saturday and 5–8 AM Sunday. Tables, $10 regular or $15 prime. All tables $15 after March 12. Tickets, $3.50 in advance, or $4 at gate. Free parking. Talk-in on 147.87/.27. Contact *Ron Morris WB8ZIM, 28141 Glenwood Rd., Perrysburg OH 43551.*

ELIZABETH KY
MAR 25

The Lincoln Trail Amateur Radio Club's Hamfest Committee will hold the Kentucky State ARRL Convention at the Pritchard Community Center. Activities include ARRL VEC exams, walk-in only, and numerous forums. Dealers and flea market vendors. Admission, $4 advance, $5 at door. Vendor spaces are $5 each, including one table and one chair. Talk-in on 146.52 and 146.38/.98. For advanced tickets and set-up reservations and information on exams, contact *Chuck Strain AA4ZD, PO Box 342, Vine Grove KY 40175. (502) 351-1715. SASE, please.*

KANSAS CITY MO
MAR 31–APR 2

The PHD ARA will sponsor the 1989 Midwest ARRL Convention at the Kansas City Convention Center. The Convention features a complete program of forums and workshops, DX, QCWA, packet, computers, ATV, ARRL, FCC, and many more. 800 commercial booths and swap tables available. Large indoor flea market, tables $10. Preregistration by March 20, $5; $7 at door. Exams (no walk-ins). Write *PHD ARA, PO Box 11, Liberty MO 64068. (816) 781-7313. Enclose SASE for confirmation or information.*

Number 34 on your Feedback card

PROPAGATION

by Jim Gray W1XU

Jim Gray W1XU
PO Box 1079
Payson AZ 85541

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20	-	-	-	-	-	20	-	-	-	-
ARGENTINA	15	20	20	20	40	-	-	-	15	10	10	10
AUSTRALIA	15	20	20	20	20	-	40	20	-	-	-	15
CANAL ZONE	20	20	20	20	40	-	-	15	15	10	10	10
ENGLAND	-	40	80	40	-	-	20	15	15	10	15	20
HAWAII	15	15	20	20	40	40	40	20	20	-	-	10
INDIA	-	-	-	-	-	-	-	-	-	-	-	-
JAPAN	15	20	-	-	-	-	-	20	-	-	-	-
MEXICO	20	20	20	20	40	-	-	15	15	10	10	10
PHILIPPINES	-	-	-	-	-	-	-	20	-	-	-	-
PUERTO RICO	20	20	20	20	40	-	-	15	15	10	10	10
SOUTH AFRICA	20	-	40	-	-	-	-	-	-	10	15	20
U.S.S.R.	-	40	-	-	-	-	-	20	15	20	-	-
WEST COAST	15	20	20	40/80	80	-	-	-	-	15	10	10

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20	20	20	-	-	40	20/40	20	-	-	-
ARGENTINA	15	15	20	20	40	40	-	-	-	-	10	10
AUSTRALIA	15	15	20	20	20	-	40/80	40/80	-	-	15	15
CANAL ZONE	10	10	20	40	40	40	-	15	15	10	10	10
ENGLAND	40	40	-	-	-	-	-	20	15	15	15	20
HAWAII	10	15	20	20	40	40	-	20	20	15/20	15	10
INDIA	-	-	-	-	-	-	20	20	-	-	-	-
JAPAN	15	20	20	20	-	-	40	20/40	20	-	-	-
MEXICO	10	10	20	40	40	40	-	15	15	10	10	10
PHILIPPINES	15	15/20	-	-	-	-	-	20	20	-	-	-
PUERTO RICO	10	10	20	40	40	40	-	15	15	10	10	10
SOUTH AFRICA	20	20	-	-	-	-	-	-	15	15	15	15
U.S.S.R.	-	-	-	-	-	-	-	20	15	15	20	-

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15	20	20	20	20	40	40	-	-	-	15
ARGENTINA	15	20	20	40	-	-	-	-	-	-	10	10
AUSTRALIA	10	15	20	20	20	-	40	-	20	20	-	15
CANAL ZONE	20	20	20	40	40	-	-	-	15/20	15	10	10
ENGLAND	-	-	-	-	-	-	-	-	20	20*	20*	20
HAWAII	10	15	15	40	40	40	40	40	-	20	20	20
INDIA	-	15	15/20	-	-	-	-	-	20	-	-	-
JAPAN	10	15	15	20	20	20	40	40	-	-	15	15
MEXICO	20	20	20	40	40	-	-	-	15/20	15	10	10
PHILIPPINES	15	15	20	20	20	-	-	-	20	15/20	15/20	15
PUERTO RICO	20	20	20	40	40	-	-	-	15/20	15	10	10
SOUTH AFRICA	20	20	-	-	-	-	-	-	-	-	15	20
U.S.S.R.	-	-	-	-	-	-	-	-	20	-	-	-
EAST COAST	15	20	20	40/80	80	-	-	-	-	15	10	10

Band conditions in March are usually the best of the year for DX. On top of that, the solar flux will be hitting the highest levels in perhaps 10 years! These *should* make band conditions superb, but we have to take into account the problems associated with the earth's magnetic field.

The greater the solar activity, the greater the possibility of flares, proton events, disappearing filaments, etc. The number of sunspots will be greater than they have been for years. When that happens, the sun becomes less and less predictable. Solar (and earth) storms appear unexpectedly. The best we can do under these conditions is to carefully monitor WWV (10 and 15 MHz AM) at 18 minutes past each hour to get the latest information on happenings for the day, and a resume of the past 24 hours, and forecast for likely conditions during the next 24 hours. This is *valuable* information.

How Not to Succeed

I continue to marvel at the number of hams I hear calling "CQ DX" when there is not one chance in a thousand that a DX station will hear them at that particular time or under those conditions. Here's a synopsis of the use of these charts. First, let's try to understand what happens with the sun and how it affects Earth.

Pay Attention to Old Sol

The sun rotates on its axis a full revolution every 27 to 28 days, and because some solar events persist sometimes for weeks, it is likely that a present condition will return in another 27 to 28 days. Groups of sunspots can exist for a long time, dissipating slowly, with new spot groups forming. The solar plasma is churning and swirling with energy, and beams of subatomic particles spew out into space and hit the Earth. The basic ionization occurs as a result of ultraviolet radiation causing the atoms of air to dissociate into electrons and ions. The ions are not randomly spread about, but, because of the earth's magnetic field, they become concentrated near the poles.

Radio signals refract from the ionized layers and patches in the upper levels of our atmosphere.

In any area on Earth, band conditions will be affected by the conditions of the ionosphere, which in turn are affected by the condition of the sun. The time of year, the time of the month, and the time of day also affect band conditions.

When the sun becomes *too* active, as in a flare, the ionosphere can become over-excited, and radio signals are absorbed instead of refracted or reflected. We've all heard the bands die when a solar flare occurs. However, the ions tend to recombine, rather than stay separated, so new atoms are formed and the process repeats itself. Thus, a major solar event may last for a day or two, with conditions on earth slowly recovering to normal activity.

MUF Chart

WWV announces solar events like flares, so you should be on the lookout for such announcements and plan accordingly. The MUF (maximum usable frequency) depends upon the degree of ionization along the path you hope to send and receive signals. The MUF increases with daylight and decreases with darkness because ionization occurs little, if at all, during the night in the layers we're most interested in. Our tables of country, time, and band, are based upon MUF conditions.

Other hours will show lower frequency openings, and then gradually higher frequency openings along a path to another country, as the ionosphere becomes more active and the active level changes height.

MARCH						
SUN	MON	TUE	WED	THU	FRI	SAT
			1 P	2 P	3 P-F	4 P-F
5 F	6 F-G	7 G	8 F	9 F-P	10 P	11 P-F
12 F-G	13 G	14 F-P	15 P	16 P	17 P-F	18 F
19 F-G	20 G	21 G	22 G-F	23 F	24 G	25 G
26 G-F	27 F	28 P	29 P	30 P	31 P	

Daily Forecast

The daily chart is based on likely occurrences of solar and earth magnetic disturbances. When a disturbance occurs, the earth's magnetic field becomes active and sometimes stormy. The "A" index, which is an overall planetary index of magnetic activity, rises and falls from values close to zero, up to values in the 30s. Zero is a "quiet" field, 10 is an unsettled field, 15 to 20 is an active field, and above 20 the field Is stormy.

On days of the week when my predictions indicate that the field will be unsettled to active, I use the letter "F" or "P" and sometimes both, to indicate the trend of conditions. On a "P" day, communications may be impossible on DX paths. On an "F" day, they may be difficult, fair on some and poor on others. On a "G" day, the field will be quiet and communications should be good for DX.

This Month

In March, be particularly attentive to conditions on the 1st and 2nd, the 8th and 9th, the 14th and 15th, and the 26th to the 31st. At these times, or on the days surrounding them, you are likely to experience active to storm-level magnetic field interference, and hence poor DX.

By the way, for those of you who live in Hawaii, or in the northwestern part of North America, Greenland, the Arctic regions, or northeast Asia, there will be a partial eclipse of the sun on March 7. 73

73 AMATEUR RADIO

APRIL 1989
ISSUE #343
USA $2.95
CAN $3.95

International Edition

A WGE Publication

VHF AND ABOVE ANTENNAS!

Wide-band discone
Hot VHF/UHF HT antenna
Tri-band vertical
Great VHF RFDer

HOME-BREW:

Uniden 10FM split mod!
New life for Bird elements
PC monitor adaptor

REVIEWS:

2m/220 MHz mobile marvel
Deluxe data decoder
Smallest full-featured HT!

Welcome, Newcomers!

VHF-AND-ABOVE ANTENNAS

VHF is not just a name for the band of TV channels from 2 to 13. It means Very High Frequency, and it applies to that band of frequencies from 30 MHz to 300 MHz. Of course, the frequencies for TV channels 2-13 are contained in this range, as well as many other services. The amateur radio service has three VHF bands, and many bands above VHF. The next segment of the spectrum above VHF is UHF (300-1000 MHz), and above that, the microwave bands (1000-300,000 MHz).

73 Magazine has in the past devoted issues to antennas covering the whole **radio frequency spectrum.** The subject of antennas has become so broad, however, that we can't begin to do justice to its entirety in a single issue. Therefore, this issue focusses on VHF-and-above antennas, and the September issue will focus on antennas for 30 MHz and below.

From Heah to Theah

Why divide the spectrum at 30 MHz? The reason is that **propagation** characteristics change radically at this point. The **ionosphere** refracts waves below 30 MHz back to Earth, which in turn refracts the waves back to the ionosphere. Waves often travel around the Earth in this vertical zig-zag pattern. It is this kind of propagation—**sky wave** propagation—which allows us to hear transcontinental shortwave stations, and distant AM stations at night.

Waves above 30 MHz pierce the ionosphere and zip out into the Cosmos. Unsuspecting alien societies in different solar systems may hear all about a VHFer's new rig or the latest Star Trek film. Earth-bound VHFers, however, have to hear about it via the **tropospheric wave**. This wave is useful only when there is a direct clear path between the transmitter and receiver. This is the kind of propagation used for television, or between a ham's mobile transmitter and a **repeater**. Normally, only line-of-sight tropo propagation is available to VHF-and-above enthusiasts.

However...

One late spring night I was watching Channel 5 on TV, which normally receives a Boston station located about 80 miles away from my home. All of a sudden, I was hearing (though not seeing well) strictly Canadian news. After a few minutes, the TV station identified its location as Ottawa—over 300 miles away! For a brief period, its signal overrode the Boston station located only a quarter of the distance away. How could this happen?

We chose this month for VHF-and-above antennas for a very good reason. The spring and summer in the Northern Hemisphere, with all its active weather, creates conditions which allow VHF-and-above tropo waves to propagate well beyond line-of-sight—sometimes thousands of miles!

The most common **DX** VHF-and-above propagation mode is **tropospheric bending and ducting.** The above-mentioned Ottawa station came into southwestern New Hampshire through a tropo duct. Another useful mode is **sporadic E.**

There are other DX VHF-and-above propagation modes which occur throughout the year, but the two above produce the most spectacular DX with even a relatively simple station set-up.

Go Forth and Propagate

Fascinated with VHF-and-above propagation and antennas? There are many fine sources of information on this, several of which are in *73*. Arliss Thompson's "Aerial View" column is an excellent monthly antenna tutorial for beginners. Chuck Houghton's "Above and Beyond" column discusses the latest happenings in the world of VHF and above, and it's ideal for those beyond the beginner level. And, of course, there's *The ARRL Antenna Handbook.*

Hope to see you on VHF-and-above DX! ...de NSIB

GLOSSARY

Radio Frequency Spectrum—The portion of the electromagnetic wave spectrum with wavelengths ranging from 30 kilometers to 1 millimeter. The corresponding frequencies are 10,000 cycles/second (10 kHz) to 3000 billion cycles/second (3000 GHz).

Propagation—The transfer of energy through a medium, such as the atmosphere, or space.

Ionosphere—An upper-atmosphere layer, ranging 75-200 miles above the Earth's surface. So called because molecules at that level are ionized (i.e., they lose electrons) by solar rays passing through them.

Sky Wave—A radio wave that travels up to, and is refracted back to Earth by, the ionosphere. A single-skip sky wave—one that is refracted just once by the ionosphere—can travel up to several thousand terrestrial miles. They are mainly responsible for worldwide radio communications.

Tropospheric Wave—A wave that travels through the troposphere, the lower part of the atmosphere that extends up six miles from the Earth's surface, by reflection.

Repeater—A machine that receives a signal and simultaneously retransmits it on a different frequency. They are normally used to extend the range of line-of-sight signals. They are very popular for mobile-to-mobile VHF-and-above communications.

DX—"Long Distance." The distance that qualifies as DX varies from band to band. VHF-and-above DX are distances well beyond the range of line-of-sight.

Tropospheric bending and ducting—The condition in which radio waves are refracted when passing through two layers in the troposphere that have sharply contrasting temperatures and moisture content. A duct is formed by a layer of moist cool air over warm dry air, which in turn sits on the Earth. Since the wave is refracted both by the moist, cool air layer, and by the Earth, the warm dry air layer acts as the duct, or waveguide. Waves of up to 10,000 MHz have travelled hundreds of miles by ducting. Ducted VHF waves have been detected from several thousand miles away!

Sporadic E—This is propagation whereby sky waves are refracted by dense patches of ions in the E-layer of the ionosphere. Waves up to 430 MHz are known to have been propagated via sporadic E. Since this layer is in the lower ionosphere, wave skip distances are shorter (typically 400-1300 miles). This is also known as "short skip."

QRM

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Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. A premium will be paid for accepted articles that have been submitted electronically (CompuServe ppn 70310,775 or MCI Mail "WGEPUB") or on disk as an IBM-compatible ASCII file. All *contributions* should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their social security number with submitted manuscripts.

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Binding Contract: See where natural ham curiosity gets you? Upon finishing reading the first sentence, you have formally contracted with *73 Magazine* to be our grass-roots ad sales person. Recognizing that we give you more ham fun for the buck than the rest, it should be a cinch to make this clear to every dealer and manufacturer you contact to exhort them to advertise with us. Remember: More ad pages = more articles.

So where does ham curiosity lead to?—more great home-brew for you!

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73 AMATEUR RADIO®

APRIL 1989 Issue # 343

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REVIEWS

DEPARTMENTS

FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

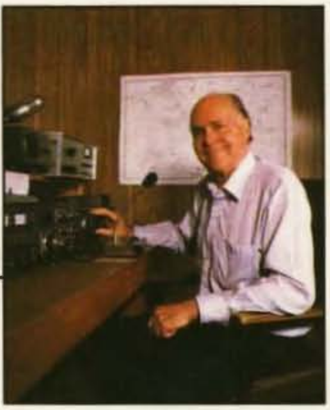
Cover: Kenwood's 2m/220 MHz mobile rig and Procomm's wide-band discone antenna.


Dayton action—be there in '89!

Number 2 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



Did the 220 MHz Loss Get Your Attention?

Judging from some recent letters, the August loss of 40% of the 220 MHz band actually managed to get the attention of some old-timers. Good grief, is it possible that Wayne may be right?

Yes, I warned you that unless we made some substantial changes, the FCC was going to start whittling down our ham bands. I also mentioned that, once we lose a ham band, we aren't ever going to get it back.

If we'd gone to the FCC with a realistic plan for the use and development of 220, I think we might have been able to hold on to it. But the FCC is well aware of the drop in new licensees and the age of the average ham, so they took the practical approach. It was us or UPS, and UPS had more political clout.

So, what can we do?

Well, if we want to stop the blood-letting, we've got to get some growth. We need to figure out how to attract youngsters, or we're dead.

The Joy of Building

One thing we haven't tried yet is to get youngsters interested in amateur radio for the same reasons we did when we were young: building. I've been writing in my editorials for several years asking you to build small home construction projects and write 'em up so I can publish them in *73*. That's why I started *73* in the first place 28 years ago.

One of the reasons I got fired from *CQ* had to do with my insisting on publishing construction projects. The publisher wanted to publish just monthly columns. Much cheaper. So when I was fired as editor and decided to start *73*, my basic idea was to publish as many construction projects as I could. And I did.

It's more difficult today, I grant you. When I started *73* back in 1960, there were over 850 ham radio stores, all carrying parts. Most of them had long counters of parts bargains, so we all loaded up with everything we thought we'd need. I had drawers full of resistors, more drawers of capacitors, cartons of tubes, sockets, connectors, jacks, terminal strips, boxes of chassis and panels—plus a machine shop with a metal brake, a drill press, and a metal punch . . . and I used 'em.

I had cartons of variables pots, coils, coil wire, high voltage wire, power transformers, audio transformers. When I moved to New Hampshire in 1962, it took four large truck loads to move all my stuff up here. I'd been stocking up on parts for 25 years, and you wouldn't believe my junk box. Hams used to bring their wives to see my Brooklyn cellar workshop and say, "And you thought my ham shack was a mess!" I had four garages full of ham equipment and parts.

I had surplus by the ton. Transmitters, test equipment, Teletypes, receivers, transceivers. As for parts, if I found a bargain, I'd buy a dozen just in case. I had cartons of toggle switches, microswitches, push-button switches, slide switches, and relays of every kind from microminiature to high power kluges.

Getting Parts for Building

Alas, the same 1963 Incentive Licensing fire storm that killed off the growth of amateur radio—and that killed about 90% of the ham dealers and 99% of the manufacturers—also virtually wiped out our parts suppliers. Today you have a choice of a few odds and ends from Radio Shack or some mail order houses, such as Ramsey, and some surplus houses, such as Meshna. You don't just go out and buy parts any more.

With the loss of our consumer electronic industry to Japan, the need for parts to be made in the US has almost disappeared. Today most of the parts we see are imported from Japan. American defense contractors who have to use American-made parts are forced in many cases to use virtually custom-made parts, even for simple items such as one-Watt resistors. This increases the cost from about a half cent to a couple of dollars each. Such are the insanities of military contracts. We're blowing millions on such crazy things.

You've read about the Akihabara section of Tokyo where there are hundreds of small shops selling electronic parts. The Japanese youngsters throng to Akihabara by the thousands to buy parts so they can build. The Japanese ham magazines have a wealth of interesting construction projects, which may be one of the reasons why there are so many young Japanese hams.

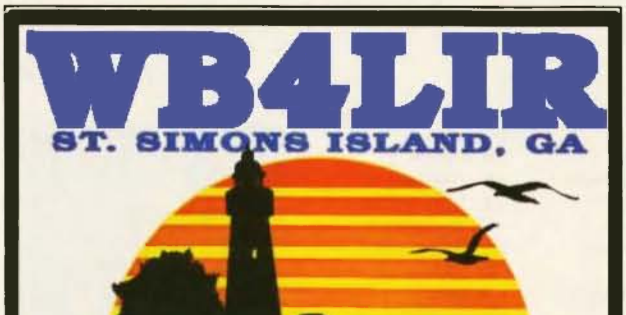
About the last bastion for ham parts in America are at hamfests such as Dayton. There you'll find the long counters piled high with parts—just about anything you could want. There were some in Atlanta, but Dayton is King.

Now I realize that getting parts is difficult, but I also know that if you want to get them badly enough, you'll find a way. What do you need parts for? I want you to get busy and start building small construction projects and writing 'em up so I can publish them in *73* and help us get youngsters into building.

You have time to write. Yes, you need some relaxation, but the average family watches TV 7.5 hours a day. We're not talking relaxation here, we're talking wasted lives. It's no wonder our kids have no concept of working or achievement. Look at the examples we're setting for them!

If you'd get at it, you could whip up at least one construction project a month. I'd not only pack *73* with them, I'd start getting ads for parts. Some entrepreneurs would start importing parts from Japan and we'd have more parts to work with. Who knows, we might eventually get kids into building and end up with enough engineers and technicians to get back some consumer electronic manufacturing. The next thing you know, we'd start seeing some parts being made in America again. If I get too many construction

continued on p. 90



QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, 70 Rte. 202 N., Peterborough NH 03458, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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QRX . . .

EDITED BY BRYAN HASTINGS NS1B

Atlas Radio Busted!

On January 26 1989, Postal Inspector Martin Biegelman arrested Michael J. Harrison, 36, at his residence of 431 Windsor Place, Oceanside, New York. Harrison was charged with mail fraud and wire fraud. He was arraigned in US District Court, Eastern District of NY, Brooklyn NY on January 26th 1989 before US Magistrate Allyne Ross. Harrison was released on a $25,000 Personal Recognizance Bond.

Victims of this fraud should contact Martin Biegelman via letter and include the following information: magazine issue of advertisement appearance, product order date, product(s) ordered, copy of front or back of check or money order sent, form of US mail used, whether or not the person received what was ordered, what representations or misrepresentations were made by Michael Harrison and/or any other person from Atlas/Dentron, etc., what efforts were made by the victim to contact Harrison, and Harrison's response(s), and any other pertinent facts. Please send this info, including copies of advertisements, letters, receipts, etc., to *Martin Biegelman, Postal Inspector, PO Box 160, Hicksville NY 11802-0160.*

Mail fraud and wire fraud each carries a five-year prison sentence and a $250,000 fine.

Home-brew Contest Deadline

You haven't yet gotten around to writing up your home-brew project to submit to our *Home-brew IV* contest? Now you have a reprieve—we have moved forward the deadline for article submissions for this contest by three months. Please note that the new deadline is July 1, 1989. (See announcement in box.) Ham fame and fortune still await you—but only for a few more months!

Looking West

Bill Pasternak WA6ITF's Looking West FM column has gone bi-monthly. Bill has agreed to become our primary QRX news supplier using the facilities of the worldwide Westlink all-volunteer organization.

U4MIR Comes To Life

Stations around the world have been reporting hearing and working U4MIR. According to Hans ZS6AKV, stations in southern Africa worked the new *Mir* station as early as Thursday, February 9. Since then, stations in Britain, Eastern Canada, and Europe have reported contacts.

Alex has made most of the contacts on 145.550 MHz simplex, and a few on 145.650 MHz simplex. Alex has kept the same operating hours as Musa U2MIR—1900 UTC and later, in the period between the cosmonauts' dinner hour and lights-out. *Mir*'s operations schedule is on Moscow time, which is three hours ahead of UTC.

Bill VE3EFX reports that the new operator's name is Alexander, or "Sasha." His English is poor and he seems to have trouble with callsigns—please speak slowly and distinctly, and stick to standard ICAO phonetics.

Pat G3IOR reports that a new crew will go up in April, and is now receiving amateur radio instruction. Continue to QSL via Boris Stepanov UW3AX, PO Box 679, Moscow 107207, USSR.

Nomadness Grows!

Those of you who have been reading *73* in '88 will be familiar with Steve Roberts N4RVE and his roving piece of tech-wizardry, the Winnibiko II. Steve and YL Maggie have temporarily alit in Silicon Valley while he is putting together the Winnibiko III. This new recumbent bicycle will feature, in addition to commercial communications devices *to run* his freelance business from the road, a packet station, HF, 2 meters, and an OSCAR Mode B setup, complete with collapsible yagis, and much, much more!

Steve and Maggie will again take to the road in the next few months—and they are looking for free spirits with the needed skills to join them in their bicycling odyssey! They plan a full-time on-the-road venture with a variety of profit centers. This may be the only way to make a living by riding a human-powered ham shack while sharpening your professional skills and expanding your range of contacts. Sound like a dream? Well. . .it is. Steve's made this dream a reality for five years.

If this strikes a chord and you want to discuss it, please write to Steve ASAP at 98 Sudbury Drive, Milpitas CA 95035. E-mail users can leave a message for Steve on GEnie. His username is WORDY.

No Code Rererevisited

Two of amateur radio's premier organizations are saying the time has come for no-code. Tucson Amateur Packet Radio (TAPR), and AMSAT North America, both issued statements that call for the creation of a code-less entry-level class of amateur license.

After careful consideration, AMSAT's Board of Directors gave its unanimous support for a code-free license for operation in the VHF and higher bands. The Board noted AMSAT's very deep concern for preserving the UHF and VHF spectrum which they feel will come under increasing attack from outside commercial interests, such as the recent case on the 1¼ meter band.

TAPR president Andy Freeborn N0CCZ and the TAPR board voted to support an amateur-initiated proposal to the FCC to provide for a no-code license class. TAPR says it recognizes the controversial nature of this issue, but that it also feels the adoption of a code-less entry-level license is critical for the future of amateur radio.

Taiwan Packet Radio

During a recent visit to Taipei, Taiwan, two US hams, Wayne Wilson WB8TSO and Denton Bramwell K7OWJ, took part in the first authorized packet radio operation from Taiwan. DU1JMG in Manila was the first station to connect. They left behind their equipment for the China Radio Association club station. Look for Tim Chen, BV2A or BV2B, on 20 meter packet radio.

903 Record?

On 27 November 1988, Dave Halliday KD5RO worked Al Ward WB5LUA on 902 MHz EME (moonbounce) from his QTH to establish a possible DX record on that band. Dave's station consisted of a 10-foot TVRO dish modified for Az-El positioning, and mounted on a single section of Rohn 25G tower. He fed this system with 220 Watts from N2WK's Hi-Spec amplifier. Al WB5LUA used a 24-foot dish fed with about 170W from a TWT amp. Terrestrial distance for the QSO: 1239 miles.

Rehab Radio Growing

Radio Time at the St. Judes Hospital station in Fullerton, California, will soon be supplemented by a mini version of Rehab Radio at the nearby Childrens Hospital of Orange County. The radio activities will be used to stimulate confined youngsters and encourage interaction. Most QSOs will be held on 2 meters for portability.

Needed are those of you willing to spend

Continued on page 11

QRX . . .

time talking with children and QSLing them. An important part of their therapy is to prepare cards and letters to send to you in return. Those taking part will probably receive a most unusual and certainly very special QSL, but only if you take the time to send out your own card after your QSO. Anyone interested in this very worthwhile project should write to *April Moell WA6OPS, PO Box 2508, Fullerton CA 92633. [Ed Note: April Moell WA6OPS is the wife of* 73 Magazine *"Homing In" columnist Joe Moell KØOV.]*

Work In 7P-Land

Interested in working in a rare DX spot? VITA is looking for someone with both radio and computer expertise to facilitate installation of equipment both at telecom in Maseru and user sites in Maseru and rural areas, and to train system users. Interested parties should contact *Dr. Gary Garriott, 1815 N. Lynn St., Arlington VA 22209 (703) 276-1800.*

Dateline Moscow

Computer viruses are the latest of typical Western ills to hit the Soviet capital. The viruses have invaded systems in at least five government-run institutions. Sergei Abramov, a computer specialist with the USSR Academy of Sciences, told Radio Moscow the first computer virus in the Soviet Union was found last August. Authorities traced the virus source to a group of Soviet and foreign schoolchildren in a summer camp at the institute.

Private Radio Docket 88-527

The FCC has proposed a one megahertz expansion of the 6 meter repeater subbands, from 52–54, to 51–54 MHz. Due to the increasing number of repeaters in the 6 meter band, the Six Meter Club of Southern California and the Southern California Repeater and Remote Base Association (SCRRBA) filed for this regulatory change.

The FCC put forth an indefinite commentary period, to give those hams who may currently use 51–52 MHz for non-repeater operation an opportunity to preserve the present band plan.

British Polar Trek

At you read this, Lawrence G4DMA and Morag GM1ILL Howell will have left for Canada once again—to Ward Hunt Island in the beginning of March for a combination of providing communications for a British Polar expedition and a 6 meter DXpedition. This year, they have gear that will permit them to run 150 Watts on 6 meters, and they will use two rhombic antennas for the high frequency links back to the United Kingdom.

The group of scientists making the polar assault will carry British PRC-319 military man-pack radio sets with the ability to run up to 50 Watts PEP out in the 2–4 MHz range. When not in communications there, Lawrence and Morag will monitor and operate 14.345 (the European VHF Net 20 Meter Intercom), 28.885 MHz (the normal 10 meter to 6 meter crossband channel), 50.110 MHz, 144.123 plus AO-13 satellite, and other bands available to them. Their callsigns will be GM1ILL/VE8 and GM4DMA/VE8.

All their communications equipment for the trek has now been environmentally tested by partial immersion in liquid nitrogen. Lawrence and Morag will remain at the base camp to maintain a communications link with the outside world, and carry out scientific experiments. Sir Randolph Fiennes is the team leader, and the goal of the expedition is to achieve an unsupported walk of about 450 miles to the geographic North Pole by at least two people. The Howells will maintain radio contact with the walking party on various frequencies during the entire expedition. Bad weather aborted their 1988 trek attempt.

Truly Turbo

The British are working on a neural network computer, a device whose memory is organized in much the same way as a human brain. US DARPA has estimated that the human brain contains 10^{11} neurons, each having roughly 1000 dendrites, giving the brain a storage potential of 10^{14} interconnects. Since nerves fire at 100 Hz, the human brain thus has the potential to make 10^{16} interconnects per second. This is far, far greater than the CRAY XMP1-2 supercomputer with its potential of 50×10^{6} interconnects per second. It's estimated that even a fly's brain can manage some 10^{9} interconnects per second!

Just in . . .

The Soviet/US ***Goodwill*** HF contest will take place 9 **April from 0000–2400 GMT.** It is for the US and the USSR only. There are two classes: one operator all bands; and multi-operator, one transmitter. Modes and bands: SSB, CW, and mixed on 10, 15, and 20 meters. US hams should call "CQU." US exchanges should include QSO number plus the state. One QSO equals one point—no multipliers. You can work the same station on different bands.

See *CQ Magazine* and the *DX Bulletin* for further info.

Thanks

To all who contributed to this month's QRX column. They are *Westlink, Indianapolis Star News, Worldradio, G8AUU, AMSAT-NA, Art Unwin KB9MZ, KD5RO, N6BVU, K5ZMS, G3VA, NT2X, and W2RS (via N6VV 10m packet). Keep your news items and photos rolling in to* 70 Rt 202 N, Peterborough, NH 03459-1194, Attn: QRX

$$ HOME-BREW IV $$

73 Magazine again invites all home-brewers to turn their hot solder into cold cash and prizes, and to get their name in print to boot. All projects have a chance to appear in the magazine, and we will handsomely reward the authors of the best of these.

Now for the bounty. Ramsey Electronics sweetened the pot from their line of frequency counters. First prize is $300, a 10-year subscription to *73*, and a CT-125 1.25 GHz frequency counter. Second prize is $150, a two-year sub, and a CT-90 600 MHz frequency counter. Third prize is $75, a two-year sub, and a CT-70 525 MHz frequency counter. All this is in addition to the payment every author receives for publishing in *73*.

Contest Rules

1. Entries must be received by 1 July 1989.
2. To enter, write an article describing your best home-brew construction project and submit it to *73*. If you've never written for *73*, send an SASE for a copy of our Writer's Guide, or download it from CompuServe (Hamnet forum, Library Ø., filename "73WRIT"). *Be sure to state on the submission that it is for the Home-brew IV contest.*
3. Here's the real challenge: The total cost of your project must be under $73, even if all the parts were bought new. Be sure to include a detailed parts list with prices and sources.
4. Our technical staff will evaluate each project on the basis of originality, usefulness, reproducibility, economy of design, and clarity of presentation. The decision of the judges is final.
5. All projects must be original. That is, they must not be published elsewhere. There is no limit to the number of projects you may enter.
6. All purchased articles become the property of *73 Magazine*.
8. Mail your entries to:

73 Magazine
WGE Center
70 Rte. 202 N
Peterborough NH 03458-1194
Attn: Home-Brew IV

Powerful Crystal Set

A "something for nothing" radio.

by Pete Haas

This crystal set has several improvements on a classic design. The speaker volume, though not ear-shattering, is plenty loud. The cumulative effects of several "tweaks" will allow the set to drive a speaker. Here's a description of each improvement.

Ferrite Tuning Coils: I used a ferrite bar instead of larger air-core coils, because the bar has a much higher Q. The main tank circuit coil is wound on a flat ferrite bar. More iron surface area is exposed compared to a round slug and fewer turns of wire are needed. In general, the fewer turns of wire needed in a tank circuit, the higher the quality will be. A junked AM pocket radio is a good source for a ferrite bar. The exact dimensions of the bar aren't critical. Just find one that's close to the one described here. The coil has multiple taps so you will have some leeway.

Antenna Matcher: The use of an antenna matcher is essential, since the characteristics of long wire antennas vary according to many factors. The big factor is antenna length, but height above the ground, gauge of wire, resistance in the actual antenna connections, moisture content of the air, and solid ground connection, all also figure into the picture. (Yes, a crystal set will work without an earth ground, but try it with and without. There's an increase in volume with the use of a good earth ground.) The matcher here is simply a loopstick and a variable capacitor in the 250–365pF range. It markedly increases the crystal set's efficiency and allows just about any length of wire to be used as an antenna. If you have an outdoor CB or scanner antenna with a long coax run of 50 feet or more, you can use the coax as a long wire antenna by attaching it with a clip lead to the crystal set. Just be sure to *temporarily* disconnect the shield from its earth ground.

". . . several 'tweaks' will allow the set to drive a speaker."

Voltage Doubler Detector: The voltage doubler produced slightly louder volume over a full-wave bridge rectifier. Technically, it's still a half-wave rectifier, but the circuit configuration uses both halves of the RF wave to charge two capacitors which fire off in series to produce twice the voltage—just like batteries do when placed in series. The voltage doubler increases volume before going through an audio step-down transformer.

Walkman Type Loudspeakers: These are passive but highly efficient loudspeakers that plug into the cassette player's headphone jack. The speakers have small powerful samarium cobalt magnets, and cones made of thin, very lightweight plastic such as Mylar. They don't rate well as hi-fi producers but they are capable of fairly loud volume with only a few milliwatts of drive.

Dual Tuning Circuit: Since two tank circuits are used, the received radio signal will have twice the current as compared to a conventional crystal set.

Selectivity Switch: This crystal set has a choice of wide or narrow selectivity. Adding a tap to L1 effectively reduces the number of turns, increasing the Q, and in turn the set's selectivity. If you want to tune in a weak radio signal that's right next to a powerful signal, the narrow position will help a lot. For maximum sensitivity and general bandscanning, use the wide position.

Construction

Dual 365 pF variables are hard to find, so I used two separate ones. There's a slight

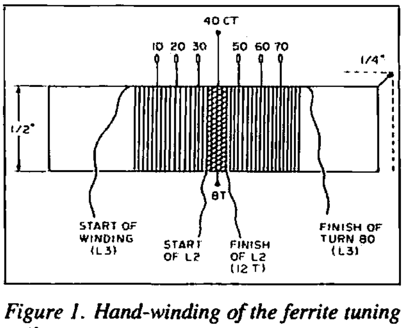


Figure 1. Hand-winding of the ferrite tuning coil.

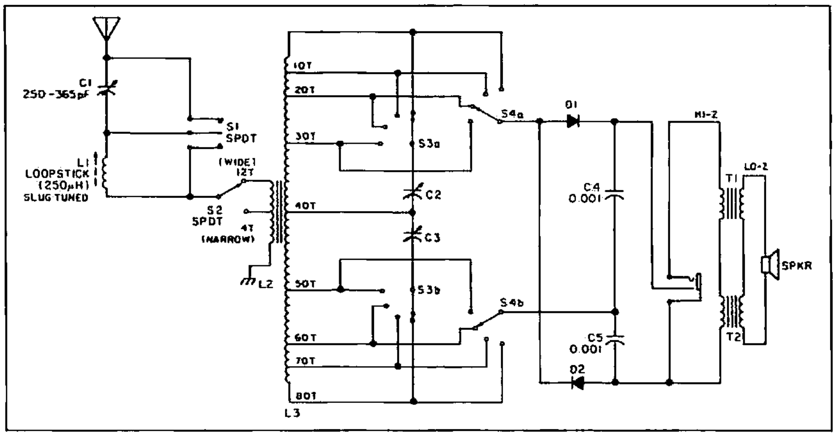


Figure 2. Schematic of the crystal set.

advantage to this. When you have a radio station tuned in for the loudest signal you may find that the mesh of the two capacitors isn't quite the same. That's because L3, which is wound by hand, does not have exactly the same inductance value on either side of the center tap. (L3 is wound on a flat ferrite bar salvaged from an old AM radio using 5/44 Litz wire. If you carefully unwind the original winding on a ferrite bar coil, you can reuse it to construct L2 and L3.)

The diodes can be any general purpose small signal germanium types. Use an ohmmeter to pick out ones with the lowest forward resistance. This will insure the loudest possible audio at the speakers.

The very high impedance transformers can be found at hamfests and in surplus parts catalogs like Meshna's. You can also use two or three transformers obtained from old tube-type radios or televisions. Connect the high impedance primaries and the low impedance secondaries in series. Though it requires more room in the project cabinet, this provides an excellent speaker driving system.

"Powering Up"

Once construction is complete, attach an antenna of at least fifty feet and hook up a good earth ground. A cold water pipe is an excellent choice. You may want to use crystal headphones to do the initial tuning. The earphone volume will be astounding. When you switch to the loudspeaker, some retuning will be necessary since the speaker/transformer combination presents more of a load and reduces the tuned circuit's Q. Using the least amount of inductance off L3 (the fewest turns of wire) will generate the loudest received audio.

There are a lot of tunable adjustments on this radio, so preserve every bit of RF energy by properly matching each component to the next. Spend some time using all the various combinations of coil taps and capacitor settings. Optimum settings will change from one end of the AM band to the other. Try the narrow selectivity and notice how radio signals tend to snap in and out as compared to a conventional crystal set where a strong station takes up half of the dial. Because of this set's exceptional sensitivity and wide tuning range, you may also hear some older cordless phone signals around 1700 kHz. The audio will have the characteristic buzz from the FM carrier, but there is also an AM component in the signal and you'll be able to make out what's being said on both sides of the conversation. Enjoy! 73

Parts List

C1, C2, C3	365 pF variables.
L1	Loopstick antenna coil (Miller 6300) or 11'2" of 5/44 Litz wire on a 5/16" OD slug tuned form (scramble wound). Coil is ¾" long. Litz wire is available from Midco, 660 North Dixie Hwy, Hollywood FL 33020.
L2	12 turns 5/44 Litz wire over center of L3, tapped at 8th turn.
L3	80 turns 5/44 Litz wire on ¼" x ¼" x 3" ferrite bar (length not critical) salvaged from an AM transistor radio. Tapped at 10, 20, 30, 40, 50, 60, & 70 turns. See Figures.
C4, C5	0.001 mF.
D1, D2	Germanium diodes.
S1, S2	SPDT switch.
S3, S4	2-pole, 4-position rotary switches.
T1, T2	Very high impedance transformer with ≈ 8Ω secondary. Try a 4800/3.2Ω or similiar, cat. #JT-19 (75¢) from John Meshna Jr., Inc., PO Box 62, E. Lynn MA 01904 ($20 minimum per order).

73 Review

by Jim Gray W1XU and Peter Pedersen W7KTK

Procomm's Wideband Supercone

Procomm/Digitrex Dist.
1948 Coventry
Thousand Oaks CA 91362
Phone: (805) 479-2397
Price Class: $100

Full VHF/UHF TX/RX coverage on a single antenna!

A friend and fellow ham, on first seeing this unusual antenna on our tower, commented that, "It ought to be called the 'star burst' antenna!" The Wideband Supercone, a discone antenna, was introduced to the public at Dayton Hamvention '88, and it immediately caught our attention. We received one a month later and have been using it since.

Light, Attractive, Easy to Install

The Supercone is a "simulated" solid discone antenna made up of a series of horizontal radial spokes which form the disc, and a series of drooping radial rods which form the cone. The cone and disc skeleton are made up of stainless-steel rods, and attach to a milled aluminum and brass center "hub." The Supercone is shipped unassembled within a stout mailing tube. Along with the assembly instructions, Procomm includes some general information to help the user understand exactly what it is he or she has received.

One major difference between this supercone and other discones is the central vertical "whip" extending upward from the center of the disc. This is a separate vertical ground plane antenna for 10 meters.

The Supercone is both a transmitting and receiving antenna. It weighs about two pounds, and it's easy to install. The width of the base of the cone is 37". With its "whip" vertical antenna, it is 69" tall. A central support element of aluminum tubing attaches to the center hub portion to allow the Supercone to mount on a standard 1¼" diameter TV-type mast.

Continuous VHF/UHF Coverage

The Supercone covers from approximately 100 MHz to 1.2 GHz in the discone portion, with added coverage of the 10 meter amateur band provided by the above mentioned, helically-wound whip. As with all discones, frequency coverage in the VHF and UHF portion of this antenna is continuous rather than discrete. That means that ANY frequency within its range may be covered with a very low VSWR in the transmitting mode.

For receiving, the discone is almost ideally suited for use with a multi-band, multi-mode transceiver and, of course, with a scanner capable of covering its wide range. Essentially, the Supercone is a neat, compact, one-antenna installation for your shack.

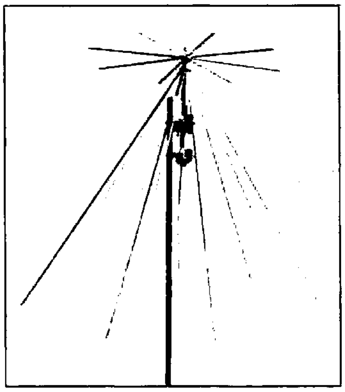


Photo A. The Wideband Supercone antenna mounted on galvanized water pipe. This Supercone covers 100 MHz-1 GHz continuously.

Fast Assembly

Our test antenna arrived in June, and we erected and tested it immediately upon receipt. From shipping container to tuneup, you can assemble the Supercone in about 15 minutes.

Because of its small size and "skeleton" structure, wind loading is negligible. Procomm doesn't take any chances, however—the "spokes" or rods that form the shape of the antenna are stainless steel. This eliminates many common weathering problems (more on this later).

We set the assembled discone on its "legs" in the shack for preliminary trimming of the 10-meter whip section. The discone portion needs NO TUNING AT ALL. After attaching a short length of 50Ω coax to the hub's SO-239 UHF-type connector (which mates with the PL-258 standard coax fitting), we attached the aluminum center tubing to the drilled and tapped central hub with a pair of 6-32 machine screws.

W7KTK's Evaluation

As of February, the Wideband Supercone has been in use for six months on 148 and 440 MHz. The feedline is 69 feet of Andrews 50Ω Heliax "hard line" with a six-foot length of RG8U coaxial cable connecting the antenna termination to the Heliax. We installed the antenna at the 50-foot level of my 65-foot tower, using a 5-foot, up-turned "L" arm to support it away from the tower legs.

The VSWR was brought as close as possible to 1:1 (as measured by a Bird "Thruline" wattmeter) on the 10 meter band while still standing on its legs in the shack. After raising it to the 50-foot level, we found that the VSWR was about 2:1 at the end of the feedline, probably due to the difference in its resonant frequency between the ground and the mounting location above ground. Heating of the plastic cap and sheath around the helically-wound short vertical antenna occurred at its tip (high-voltage end) with 100 Watts RF input applied to the transmitter end of the feedline. The heating caused a softening and deformation of the cap and the plastic sheath.

We removed the 10 meter vertical portion, and conducted further tests on 122.8 MHz (aircraft "Unicom" frequency), 147 MHz (a nearby repeater frequency in the 2 meter band), and 444.5 MHz (a 70-mile-distant repeater frequency in the amateur 70 cm band). The measured VSWR by the Bird wattmeter was 1.2:1 at 122.8 MHz, 1.1:1 at 147 MHz, and 1.1:1 at 444.5 MHz. This is a very creditable performance.

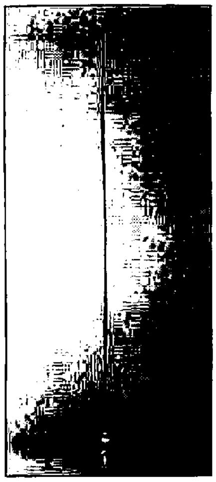
The "expand-to-five" attachment and the several whip antennas needed for operation on the HF bands may be practical, but we did no tests on them.

Improvements and Suggestions

The aluminum tubing support required a bit of re-working to provide a stable attachment to the center hub so that it wouldn't wobble. It was simple to replace the two-screw support with a three-screw support arrangement, with each machine screw fitted into a tapped and threaded hole 120 degrees from each other around the periphery of the hub. We understand from Ray Lukaszewicz that this has become a permanent "fix" on antennas now being delivered. The antenna mounting is now rigid and strong.

After six months of use, we have noted some galvanic action between the threaded ends of the stainless steel radial rods and the aluminum/brass center hub, as evidenced by a deposit of whitish aluminum oxide that nearly prevented easy disassembly of the antenna when it was taken down. The factory informed us that a small packet of conductive no-oxidation grease, similar to the type electricians use for joining aluminum tubing and protecting telescoping joints, now ships with every antenna. This is an inexpensive and simple addi-

continued to p. 43



Low-Cost Easy-to-Build Antenna

For 146/440 MHz.

by Bob Witmer W3RW and Ed Clegg W3LOY

This easy-to-build antenna provides improved performance in range on both bands over the standard antenna ("rubber duck") currently supplied with the dual-band, hand-held transceiver. In addition, at less than 2 feet tall, it's space-efficient for mobile operation.

The Challenges

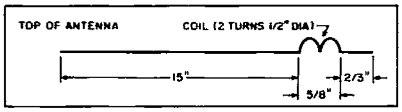
The recent popularity of compact dual-band 146/440 MHz FM transceivers has created an antenna problem for those owners who desire improved performance over the standard antenna. Improved performance antennas are available separately for both bands, but you have to change antennas when you change bands. This is hardly convenient.

We discovered, quite by accident, that this antenna, originally designed just for gain performance over a quarter-wave on 440 MHz, had dual-band capability.

How It Works

The antenna works in different modes on each of the bands. On 146 MHz, the performance is virtually identical to a quarter-wave whip. At this frequency, depending on the ground plane configuration, the performance can be significantly superior to the rubber duckie antenna, even within a small fraction of a dB of a conventional quarter-wave located in the same ground plane environment. The SWR characteristics and bandwidth also behave similarly to a quarter-wave monopole.

The real virtues of this antenna appear in the 440 MHz application. Many have been surprised to find that they were able to get some measure of performance when they operated on 440 MHz with a conventional 146 MHz whip. The fact is that a 146 MHz whip looks like a ¾-wave whip when used at 440 MHz. It presents a very acceptable SWR to the rig. Any piece of wire will radiate to some degree, in some direction. And there's the rub—*some* direction. Most of the radiation from a ¾-wave vertical whip over a ground plane is directed up into the sky! It will send a nice signal at about 48 degrees above the horizon. That's not where we want our signal to go most of the time!



Dimensions for the dual-band antenna.

The easy-to-build antenna, while occupying essentially the same space as the 146 MHz vertical whip, behaves quite differently on 440 MHz than the above sky-warmer. The secret is in the current distribution resulting from the addition of the "curly-Q" inductor inserted into the lower part of the whip. Because of the resulting current distribution, the antenna behaves similarly to the classical ⅝-wave vertical, which not only provides several dB of gain over a quarter-wave whip, but also directs its radiation along the horizon where we want it to go. (For a copy of the current distribution plots and MININEC radiation simulations for this antenna, send an SASE to the authors at *146 Forest Trail Dr., Lansdale PA 19446*).

The curly-Q inductor not only establishes the ideal current distribution, but also performs the impedance matching required to make a highly reactive, high impedance ⅝-wave whip look like the 35–60Ω resistive load we want to match to our 50Ω rigs!

Construction

The antenna is simple to build. Actual dimensions vary slightly, depending on the application, but in any case appear to be non-critical. Forming the base loading coil is the hardest part of construction. When constructing my mobile antenna, I worked with a stainless steel whip and formed it as such. It was difficult. I used 18-gauge Copperweld wire to construct the antenna for my 146/440 MHz handheld. It was considerably easier to form!

The easiest way to start construction of a mobile antenna is to obtain a quarter-wave VHF commercial high-band mobile antenna uncut for the operating frequency. This should provide you with all the material you need. Simply measure the antenna for the location of the loading coil, form the loading coil, and mount the antenna on the mounting base. Construction of a hand-held version is similar. Use any conductor material which will give you the desired size and structural integrity.

When selecting the material for your dual-band antenna, remember that you have to attach it to the antenna connector on your handheld. When I used 18-gauge Copperweld wire, I chose a BNC connector with a screw stud, left over from a broken 2 meter rubber duck. I formed a loop in the bottom of the antenna, and attached the connector and screw stud with a matching nut.

Adjustment

The next step is to trim the antenna for optimum 2 meter band operation. 440 MHz SWR usually does not appear to need adjustment since observed SWRs have not been higher than 2:1.

Performance

Mobile performance of my magnet-mounted version on 2 meters is indistinguishable from that of a regular quarter-wave whip. 440 MHz performance approaches that of a commercial "5 dB gain" antenna.

Performance of the portable version, which I have used on my 146/440 MHz handheld, shows a noticeable improvement on both bands over the standard antenna supplied with the rig.

On a 35-mile path with 3 Watts, 440 MHz operation proved superior to that with 30 Watts into the 2 meter whip, and gave barely detectable difference when compared with an expensive commercial vertical collinear!

SWR was not measured on the handheld. Complexities associated with antenna SWR on handhelds precluded such measurement. I have used this antenna with my HT, however, for quite some time, with no troubles.

Summary

This low-cost antenna is space-efficient and easy to build. It gives you greater range and versatility over the antenna supplied with your handheld transceiver.

For information on the availability of a commercial grade Clegg dual-band antenna, contact *Viatek, Inc., 350 Main St. E., Allentown PA 18106. Phone (215) 395-7222.* ■

Hamfest Survival Guide

Make the most of your time and money.

by William E. Newkirk WB9IVR and Robert L. Burton, Jr. AA4QA

Hamfests are the social event of the amateur radio world. Many people who go to hamfests don't think of the little things that could increase the enjoyment, comfort, and value of their trip. Here are some of the ones we've thought of.

Good Advice

1. Wear loose fitting, comfortable clothes. It gets very hot inside the exhibit hall because of all the people.

2. Park away from the crowd. Hamfest drivers are some of the worst we've ever seen. They get to talking on the mobile rig and run right into things. Look for a parking place away from the congestion, with trees for shade.

3. Pack a cooler full of food and iced drinks. The food at hamfests is often expensive and bad. With the heat and activity, dehydration can be a problem. If you have heart problems, take at least a 10-minute rest every hour.

4. If you are in the market for new gear, remember most retailers give 20% discounts at hamfests. But get there early in the day to do your shopping. By late afternoon, the good stuff has usually been sold.

5. Always barter, even when buying new equipment! People come to a hamfest to get a good deal, and the sellers know it. Expect to get even bigger discounts on used gear.

6. If you are a Novice, don't be afraid to ask someone for help. Buying your first rig can be a little overwhelming. If you don't know anyone there, go to a club table or the QCWA (Quarter-Century Wireless Association) booth and ask for help. If you have an Elmer, but you can't locate him, have him paged or ask someone with a handy-talkie to call him.

7. Don't be shy about asking questions. Ask as many questions as you can! Talk to everyone. What is this for? Who are those guys in the funny orange vests? Why is that guy wearing a dish on his head? Hamfests are a great place to meet people with like interests and to learn from each other.

8. If you don't want to buy any equipment, check out the books. In the dealer section (i.e., "new gear"), many companies sell a wide selection of how-to books as well as operating aids and maps, call directories, and software.

9. When buying used gear: a) don't buy military surplus unless you are a collector; b) don't buy any gear over 20 years old; and c) don't buy any gear too big to carry.

Good Used Rigs

Heathkit HW-101, SB-10X series (e.g., SB-102, SB-104, etc.) gear can be fixed with very little test equipment, and the manuals are great. Prices range from $100–150 for a 5-band transceiver in working condition, with manuals, to $30–75 for gear in not so good condition. Keep in mind that most of this gear can be repaired and parts are available.

What follows is a typical event from the results of bargaining:

1. Old HW-101 5-band rig, less manual and power supply. I paid $35: the man was asking $50. (Rigs of this vintage all had separate power supplies, typically requiring 250 volts, 6 volts, 450–700 volts DC to operate.)

2. HW-102 power supply bought for $10 two aisles over from the first purchase.

3. Manual bought with power supply, total cost $45.

4. Repairs: three new filter capacitors $4 each, $12 total; three new final amplifier tubes (I bought these just to be sure) $6 each, total $18.

5. Total cost of 5-band radio = $45 + $12 + $18 = $75.

Other Good Tnbe Rigs

Drake TR-3/TR-4. Five bands, 300 Watts output, used price, $200–300. Power supply and speaker or headphones are separate. Last variant was the TR-4cw with provisions for optional CW filter. Noise blanker optional. Another popular product line was the **R-4n** and the **T-4Xn** series. The last produced variant was the R-4C and T-4XC. The **T-4XC** needs a separate power supply, and the receiver needs a speaker or headphones. The receiver can be set up to accommodate any frequency in the HF spectrum from 500 kHz to 30 MHz (except 5–6 MHz). The receiver's VFO can control the transmitter for a general coverage receiver/transmitter combination. The FS-4 synthesizer eliminates the need for a small army of crystals on the R-4x receiver. The FS-4 is a rare item.

Swan 500 transceiver. Five bands, 500 Watts output, used price $250-400.

Collins 32S-( )/75S-( ) and **KWM-2( ).** Five bands, 100 Watts output, used price of $400 and up (collector's item). This product line was discontinued in the mid 70s, but the popularity of the units in their prime has created a small but dedicated support system of after-market companies.

National NCX-5. Five bands, 180 Watts output, used price $150 to $300. **NCX-3.** Three bands (10, 15, 20), used price $100 up.

Newer Transceivers

Kenwood TS-5x0 series. Solid-state with tube finals. 100 Watts output, $300 and up. **TS-120.** Solid-state, 100 Watts output. Has a typical used price of $200 and up. **TS-130.** Like TS-120, but includes 1979 WARC reassignments (10, 18, 24 MHz), somewhat better receiver. Has a typical used price of $300–400.

ICOM IC-701, 720, and **721.** All solid-state. 100 Watts output. $300 and up. Some units may be remote-controlled by optional controller.

Drake TR-7. Solid-state, 100 Watts output, used price of $500 and up.

Yaesn FT-10X series. This is the choice of illegal operators in the US. Originally, it came with one band set up for the 27 MHz Citizen's Band. The FT-101 and follow-ons are good gear and work well. They have up to 100 Watts output and are all solid-state except for tube finals. They sell used for $300 and up.

New Transceivers

Kenwood TS-140/TS-680. All bands plus general coverage receiver. 180 Watts output. $800—1000, depending on options.

TS-680 includes 50–54 MHz operation in place of a built-in VOX circuit. **TS-440:** All bands with lots of extras, 180 Watts output, but $1000+. **TS-430:** All bands, older version of the TS-440. $600+ if you can get someone to part with one.

ICOM IC-735. Like the TS-430/440. In the $800—1000 price class. It has an excellent receiver section.

Problems with Old Gear

Tube Gear must run off high-voltage, and it isn't portable. It may take some work to get it running. Of course, you may get lucky. Many new hams find tube gear a cheap way to get on the air. All of the models mentioned work well and have parts and tubes available for them. There are companies that produce and market solid-state replacements for tubes! When looking for older gear, Heathkit is one of your best bets.

Home-brew. If you're interested in home-brew, there are some nice designs out there, but the cost is equivalent to purchasing good used gear. Home-brew takes a lot of work. Still, you should consider this if you want a modification you can't buy, and have a lot of patience.

New gear is very nice, but the prices are going up and up with the price of the yen. Get to the hamfest early and shop around. Try to get the best price and buy it now before the price goes up again.

Testing Gear Without Power

When checking out a piece of gear, there are many things to look for. Here are some common items to check for when you are examining flea market gear. First, we cover evaluating a rig when you don't have a power source, then we give a checklist for testing the rig with power.

1. Is the equipment clean? Is the paint in good condition? Little or no rust?

2. Is the operating (maintenance and service) manual with the radio? Is it complete, without missing or unreadable pages?

3. Check the fuse. Is it good, and of the correct value?

4. Check for missing cabinet/chassis screws.

5. Check inside for loose hardware.

6. Is the control panel labeling clear and readable?

7. Check for smooth switch operation. For example, if the band switch is hard to move, or turns roughly, it might need repair or replacement.

8. Be sure that the controls turn without binding or backlashing, and that they have no loose couplers or universal joints. Check the main frequency tuning knob, and especially the driver and final amplifier output knobs on tube transmitters. If they wobble or move too freely, the couplers are loose and perhaps defective.

9. Check the frequency dial for excessive wear. For example, a part of the frequency dial's lettering may be worn off.

10. Check for missing but needed connectors, like the octal plugs used for connecting other gear to the rig. Another special item is the TS-520's VFO jumper plug, needed when no remote VFO is used. This is very important. You can't operate a radio until all the connectors and cables are installed for proper input, output, and bypass hookups, no matter how pretty it looks! These items may be available at the show.

11. Check for missing components, like noise blankers, crystals, or crystal decks for receiver local oscillators, tubes, dial cords, and bandswitch drive chains.

12. Check for broken, sprung, or bent meter pointers or movements, cracked meter cases, and out of place meter scales. If any knobs are broken or cracked, you will probably find replacements at the hamfest.

13. Check the tubes. Are any cracked? Are they all marked with their tube types? Or is this in the manual? Many good tube sets will have the proper tube type designator stamped next to its socket. However, this may be covered by years of dust, so bring a small rag to clean around the tube socket. Don't handle the tubes with your fingers whenever possible, since oils from your fingers can deposit on the tubes and heat up and weaken that part of the tube.

14. Check ON/OFF switch continuity through the power cord with a volt-ohmmeter. This should be open when the power switch is off and a low ohm reading when the power switch is on.

Testing Gear with Power

1. First, check all the items above.

2. Check for voltage programming before plugging in the power supply (set adjustable units to the current voltage in your area). Most late models have a selector switch in back near the power connection.

3. If possible, check power supply output voltages before connecting the unit. Make certain the cable from a separate power supply has all the proper voltages on the proper pins of a connector before hooking up the rig.

4. Apply power and see if all pilot lamps, displays, and indicators illuminate properly.

5. If possible, check for proper operating voltages inside of unit.

Receivers

6. You should hear at least some static in the receiver's speaker. This noise should increase if you touch your finger or screwdriver to the antenna input. You should be able to hear some signals on most bands, in most cases. A working calibrator with minimum static implies the antenna isn't connected to the radio (bad T/R relay? cold solder joint?) but doesn't indicate problems elsewhere in the receiver.

7. Check both speaker and headphone outputs. You may need a spade lug to an appropriate phone/phono jack, or other adapter, so headphones can double up for this job.

8. Check for excessive hum in audio (bad power supply, filter section).

9. Check the controls for noisy operation.

10. Does the receiver hear signals in all receive modes—upper sideband, lower sideband, and AM?

11. A radio may have a problem only on USB due to a bad switch, crystal, or oscillator.

12. Do the switchable filters affect speaker noise or selectivity?

13. Check the notch filters, Q-multipliers, etc., and how they affect the received signal.

14. Check the passband filter tuning. How does it affect the received signal?

15. Check AGC FAST/SLOW control, and how it affects the received signal.

16. Check the receiver calibration with WWV (10 MHz, 15 MHz AM) or CHU (7.335 MHz USB). If your receiver is tuned, you should hear the same pitch for either sideband setting on WWV.

17. Check RIT/clarifier controls for clean operation.

Transmitters

18. Test output power using a common light bulb of sufficient wattage. This way, you can quickly check tube transmitter output on all bands (though a dummy load and wattmeter would be better). This may be wired to a connector and plugged into the antenna terminal. For many rigs, like the TS-520/FT-101/T-4XC, use a 100 Watt lamp. Rigs like the TR-3/TR-4 require a 150–200 Watt lamp. Most solid-state power amplifiers in the amateur radio market will probably reduce power because of the bulb's reactance; this results in poor output even when everything is really in good shape.

19. Make sure the input current to finals is close to the normal values given in the operation manual.

20. Use a frequency counter or receiver of known quality to check the transmitter's frequency calibration.

21. If possible, bring a small receiver (e.g. a Ten-Tec Argonaut) and an attenuator to attach to it, to avoid front-end overload. Attenuators are inexpensive to put together, and you can find the plans for them in the *Handbook* and other sources. Use this setup to estimate audio quality and distortion of the signal of the transmitter in question.

22. Using the setup in #21 estimate sideband suppression on sideband modes.

23. Again with the setup in #21, check for key clicks, backwave, splatter, and harmonic radiation.

24. Does the peak power output correspond to the minimum plate current? If not, this can indicate that you may need to adjust neutralization on the final amplifier.

25. Check the XIT/transmitter offset controls; do they vary transmitter frequency?

26. How well does the speech processor work?

27. Check the idle current on the final amplifier. On many tube transmitters, go to SSB and key the transmitter, but don't modulate. The plate current displayed on the meter will be the idle current. For many finals using 6146-type tubes, this is around 60 mA.

We hope you find the information in this guide to be helpful the next time you go to a 'fest. See you there! 73

How to Feed an Apple to an IBM Monitor

Feed a digital RGB monitor from your Apple for under ten bucks.

by W.K. McKellips WB4DCV

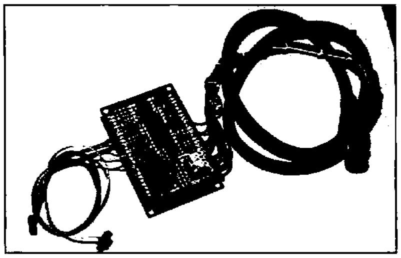
In the times before PC clones (1980), I bought the Apple II+ and paid a bundle for it. I didn't buy a monitor then because it cost too much. Instead, I bought a little add-on RF modulator so I could feed the computer output into the antenna jack on an old Zenith black and white TV I had sitting around.

The setup worked, but the text on the screen was like a message from Mars. I even had a little static in there with it. What I most definitely needed was a real monitor! But that meant spending more money...

When the next hamfest came along, off I went and came back with a pretty little composite color monitor. Wow! Now the text was readable. The colors were great and I was in computer heaven—for about six months. Strange! I noticed that the text still wasn't as sharp as the monitors at work. I was told I needed an RGB job. So I bought one.

Getting In Deeper

Now I was really in for it. In order to feed my Teknika RGB monitor, I needed an RGB adapter card. I'd also need an eight-wire cable with a DIN plug on one end and a DB-15 plug on the other. The salesman at the computer store didn't think his card would match the monitor to my old Apple II+. I'd have to have a special cable made. He knew a guy in the next town that used to make cables, but he wasn't sure if the guy was still alive. The rut got deeper and deeper.



The adapter and cable that plugs into the Apple motherboard and an the IBM monitor.

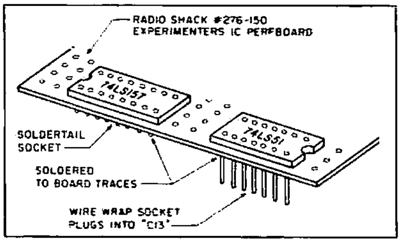


Figure 1. Edge of the Radio Shack #276-150 perfboard, on which the video adapter circuit is wired. Remove the 74LS51 IC from its socket on the motherboard, insert socket plugs, and reinsert the chip into the socket.

Ham Ingenuity

Enter the Ham Spirit. I was truly tired of the crude graphics, and was determined to have a good, crisp, single-color display for my word-processing and databasing.

I consulted my Teknika owner's manual and noted which pins on the DIN connector went where. I then looked over the schematic for the Apple. Duck soup! On the Apple motherboard, the IC at location C13 is a 74LS51. The combined vertical and horizontal synchronizing signals leave the 74LS51 on pin 8 and mix with video at the base of Q3, a 2N3904. If you have an Apple-type monitor, you're already there. You've got your combined negative horizontal and vertical synch. All you need is some positive video from the Apple output jack. In the meantime, I'll show you how to feed an IBM style monitor.

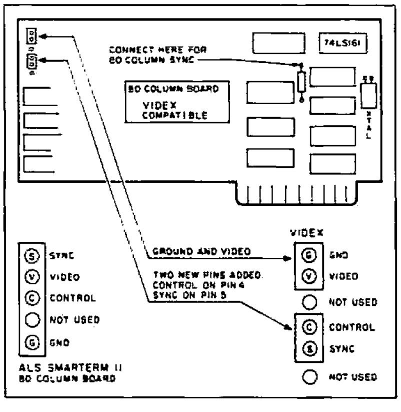


Figure 2. Diagram of the Videx compatible 80 column board. The solder pads in the upper left corner of the card are the connection points to the adapter. Lower left of the figure shows the adapter connection points for the ALS Smarterm II 80-column card.

Only Two Ingredients

All you need to do is take the combined synch, separate the vertical from the horizontal, and invert. This is neatly done with a single 74LS157 and a transistor. Grab the video and give it a little boost and you have all the ingredients for your IBM RGB!

I didn't want to dig into the printed circuit motherboard, so I assembled the adapter on a small Radio Shack experimenter's board (RS #276-150). Ninety-nine cents seemed like a good price to pay for an adapter board. My version was hand-wired, but a printed circuit board would look prettier.

The board is about two by three inches with the input leads soldered on one side, and the monitor cable leads on the other side. It plugs into the Apple motherboard, and the cable is wedged into the cable slot at the back of the Apple to give the leads slack. The "case ground" wire in the cable is grounded to the bottom plate with a small alligator clip.

Making the Connections

See Figure 1. We make the necessary connections by pushing a wire-wrap 14-pin socket through the holes on the Radio Shack board and carefully soldering each pin to the board. Try to find a wire-wrap socket with the shortest pins so the assembly won't set so high on the motherboard. While we're at it, solder a 16-pin soldertail socket on there, too. The wire-wrap sockets are also available at Radio Shack.

Now plug the original 74LS51 into the

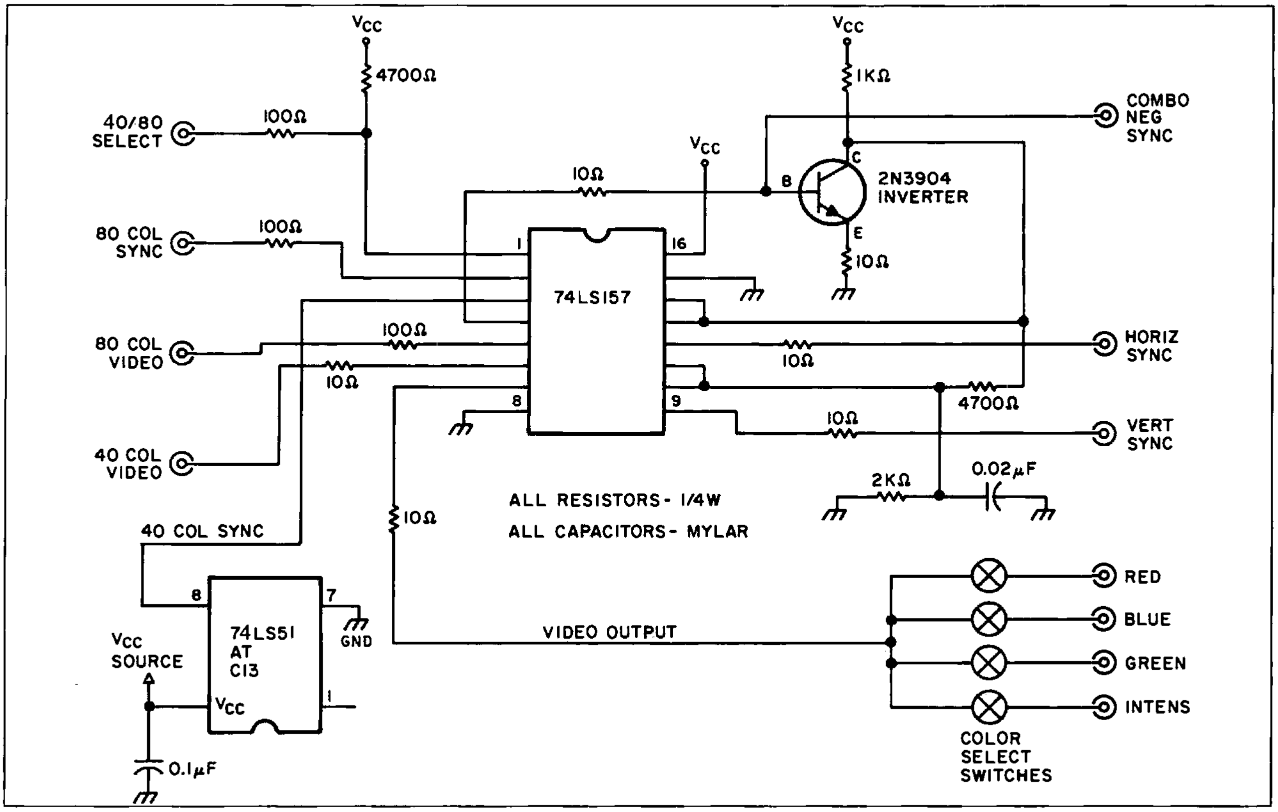


Figure 3. Schematic of the video adapter.

wire-wrap socket and plug the wire-wrap socket into the motherboard socket at position C13. Please note the IC is oriented with pin one facing the keyboard. The pins on the wire-wrap socket are larger than IC pins, so be careful when you ease it into the socket at C13.

To get our signals, we run three wires from the 74LS51 socket to our 74LS157. These furnish ground, VCC, and 40 column synch.

Circuit Operation, In Brief

For our project the 74LS157 is a fancy four-pole double throw switch. Two of the "switches" switch from 40 column to 80 column synch with video to match. The 2N3904 inverts the signal, and the other two 'LS157 sections are wired to separate the horizontal from the vertical synch.

Switching from 40 to 80 Columns

Your 80 column card, if you have one, makes it possible for you to switch from 40 to 80 column mode. If you don't have one, then ignore all the 80-column connections. Just run a wire from your 40 column video, "V40" to an RCA plug, and plug it into your Apple video output jack.

Figure 2 shows samples of ALS Smarterm II and Videx control sockets. The ALS card switches your adapter board automatically when you type "PR#3." The Videx compatible board has six solder pads for a control socket. There is a miniature 2-pin connector on the top two pads. The first is ground, the second one down is video. The third one is VCC. Install another miniature 2-pin connector on the fourth and fifth solder pads. Pin four will be our 80 column control wire (it's a ground). Run a small wire from pin five (formerly unused) to the top of the 2200Ω resistor located in the top right hand corner of the Videx board. That's where you'll find the 80 column synch. We don't use pad six.

The Video Adapter Board

On the Videx board, you automatically go to 80 column mode when you plug your cable into it. A high on the control line gives you 40 columns, and a ground or low, switches you to 80 columns. If your 80 column board doesn't have a control signal, then use a miniature switch to ground the control line for 80 column mode.

Video output on the adapter board is divided up between Intensity, Red, Blue, and Green output. The output impedance for the 'LS157 is mismatched to the cable line, but since my monitor cable is only three feet long, there is no apparent degradation of the signal. See Figure 3.

Note that in IBM monitor mode, you would use the horizontal and vertical synch outputs. For an Apple monitor, use the combo synch output and don't use the HORIZ or VERT outputs at all!

On my version, I mounted a small DIP switch in series with the red, blue, green, and "intensity" outputs. This allowed me to have an all-green or all-amber text screen, as desired. As it turns out, I didn't like the green-screen effect, but there may be some people who do, so I'm including that circuit in the diagram. Juggle the switch settings to get any single color, or white, as you want.

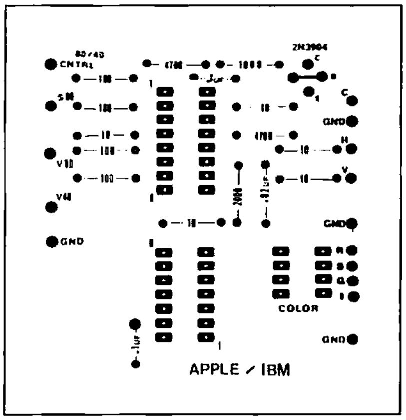


Figure 4. Suggested perfboard parts placement for the adapter.

The adapter, as shown, runs perfectly on my Teknika MJ-22 in IBM mode. There isn't any reason why it shouldn't work equally well on any other make of RGB monitor. If one is willing, or if one is Scotch (as I am!), just check the users manual that comes with the monitor, and prepare a cable. The adapter board schematic shows where the wires go. If one exercises the Ham Spirit, one can build it. If one builds it, one saves much money!

Number 9 on your Feedback card

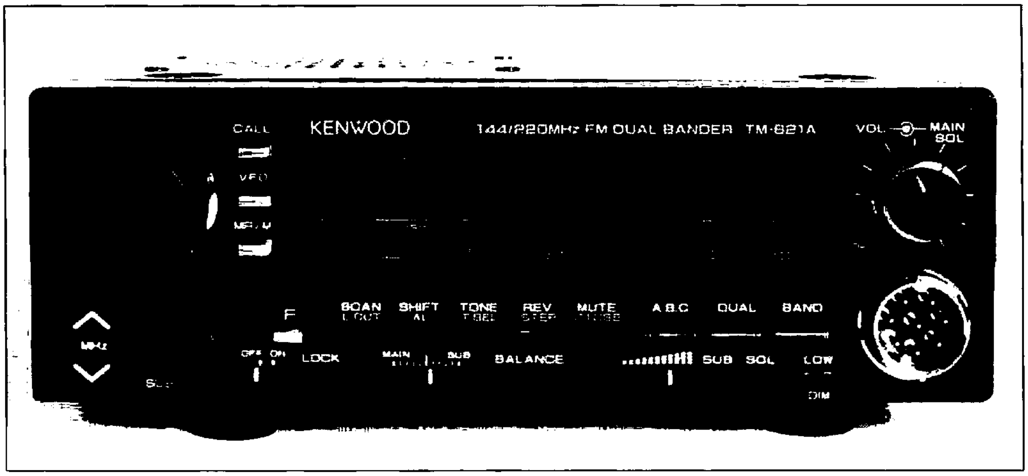
73 Review

by Paul Grupp KA1LR

Kenwood TM-621A

Kenwood USA Corp.
PO Box 22745
Long Beach CA 90801-9745
(213) 639-4200
Price Class: $730

144/220 MHz FM Dual-Band Transceiver



The Kenwood TM-621A—the world's first 2m/220 MHz dual-band mobile rig in a single box.

Throughout the late 70s and the early 80s, most hams who operated mobile did so on a single band: 2 meters. Now, in many metropolitan areas, 2 meters has become so crowded that normal QSOs are nearly impossible. This crowding has forced increasing numbers of us to migrate to 440 MHz, and most recently, 220 MHz. With the notable exceptions of NYC and LA, these bands are relatively uncrowded throughout the country. You can listen to a repeater for hours without hearing a "kerchunk," and the term "QSO" still refers to a conversation between individuals, rather than a round-table with a cast of thousands.

For several years now Kenwood, ICOM and Yaesu have made dual-band transceivers which cover the 2 meter and 440 MHz bands. But, if you wanted to have 2 meters and 220 MHz in your mobile installation, you had to install two separate rigs. With the introduction of the new Kenwood TM-621A, this is no longer the case. Now 220 MHz fans can have their cake and eat it, too! The TM-621A is identical in features and packaging to the 144/440 MHz Kenwood TM-721A.

Features and Controls

With the power turned off, a casual observer might conclude that the TM-621A is just another compact 2 meter transceiver. Turn it on and the dual frequency displays light up, suggesting that something more interesting might be going on here. The TM-621A is a dual-band radio in the sense that it can receive on two frequencies simultaneously, and a variety of unique controls and displays are provided to support this type of operation.

The frequency display on the left is referred to as the "main display," and the slightly smaller one on the right is referred to as the "sub display." Either band can be monitored on either display, although you can't monitor the same band on both displays. The sub display functions as a dumb monitor receiver. It can monitor the VFO or memory frequency of your choice, but that's about it. All transmitting is done from the main display, and the various scanning features are active here. Each display has a separate S-meter.

> ***"Because the two receivers are truly independent, full duplex operation (on separate bands) is possible."***

Obviously, useful monitoring of two bands simultaneously requires some special controls, and Kenwood has provided them. Each display has its own VFO knob, used either to tune up and down the band, or to select a memory. The MAIN SQUELCH is located concentric with the volume control, while the SUB SQUELCH is a sliding control located near the bottom of the front panel.

The BALANCE control adjusts the relative audio level of the main and sub receivers (the receiver audio is mixed internally before it is sent to the single internal speaker or rear panel audio output jack). The MUTE switch drops the audio level of the sub receiver by about 20 dB, allowing you to give your attention to the main receiver without disturbing the setting of the BALANCE control.

Pressing the DUAL switch deactivates the sub receiver, causing the TM-621A to function like a conventional single band transceiver. This is useful for public service or emergency operation where you are only interested in one band.

The BAND switch exchanges the frequencies in the main and sub displays. The ABC (automatic band change) switch activates an entertaining mode which performs the same function whenever a signal is received on the sub display frequency. This first appears to be a mere gimmick, but it is actually quite useful. Suppose, for example, you are waiting for a friend to call you on the sub display frequency. Without ABC, you'd have to switch bands manually to answer a call, since the rig can't transmit on the sub frequency. The ABC considerately handles the job for you.

Because the two receivers are truly independent, full duplex operation (on separate bands) is possible. You don't have to do anything special to use this feature. Just grab the mike and start transmitting—the sub receiver remains active. On simplex frequencies, or in an area with linked 2 meter and 220 MHz

repeaters, full-duplex operation can be quite an enjoyable experience.

That completes our tour of the controls and features relating to dual-band operation. The rest of the controls are comparable to those found on any other full-featured transceiver. Describing them here in detail would require several pages. Suffice it to say that nearly every conceivable feature is provided for, including scanning, automatic offset selection according to the ARRL band plan, and CTCSS encode and decode (with an optional accessory).

Dimensions	(W x H x D) 5.9" x 2" x 8.6" (150 x 50 x 219 mm.)
Weight	3.97 lbs. (1.8 kg.)
Power requirements	13.8 VDC ±15%; <9.5A TX, >0.6A RX
Receiver circuitry	Dual-conversion superhet
Sensitivity (12 dB SINAD)	144 MHz: less than 0.2 µV 220 MHz: less than 0.18 µV
Selectivity	−6 dB: more than 12 kHz −60 dB: more than 24 kHz
Spurious response	Better than 60 dB
Audio output	More than 2 W into 8Ω (5% distortion)
RF output power	144 MHz: 45 Watts 220 MHz: 25 Watts

Table 1. Manufacturer's Specifications.

Connections and Accessories

The TM-621 has the same 8-pin mike connector found on every Kenwood radio produced in recent years, so any mike or TNC cables wired for Kenwood gear will work here without modification. The MC-48B DTMF microphone is furnished as standard equipment.

As with many other compact radios, all connections to the rear panel (with the exception of external speakers) are made via pigtail leads. The large heat sink fins simply do not allow room for conventional antenna and power connectors.

Tantalizingly, there is a knockout on the rear panel for a third antenna connector, and unused space and mounting holes inside the rig for another power amp board. One might speculate that some future version triband radio is planned for the same chassis. But bear in mind that this would require a complete redesign of the rest of the radio's boards, since there is absolutely no way that they could be easily modified for this application.

There are separate antenna connections for 2 meters and 220 MHz, which means that you'll either have to use separate antennas for each band, or attach an accessory duplexer and dual-band antenna. At press time, no manufacturers were offering duplexers or dual-band antennas for 144/220 MHz.

In general, the manual provided with the TM-621A was well written and complete. However, I was dismayed to note that the adjustment instructions Kenwood usually provides for low power output, mike gain, beeper level, etc. were absent. I hope this doesn't reflect a trend!

Circuit Configuration

The TM-621A offers generous out-of-band frequency coverage (receive-only as shipped from Kenwood). It covers from 138 to 173.995 MHz, and from 215 to 229.980. This extended coverage is useful for monitoring a variety of public service transmissions, including NOAA weather at around 162 MHz. Power output is rated at 45 Watts on 2 meters, and 25 Watts out on 220 MHz.

You might naturally wonder if performance compromises were necessary to obtain dual-band operation in such a small package. An examination of the schematics and block diagrams provided with the TM-621A quickly puts those fears to rest. From an RF point of view, there are in fact two separate transceivers inside the single box. On the receive side, each band has its own bandpass filters, RF amps, mixers, and IF stages. On the transmit side, each band has separate PLL, VCO, drive, PA, antenna switch, and low-pass filter circuits. The only shared circuitry is in non-critical areas like microprocessor control and audio amplification. Because Kenwood was free to design separate RF sections for each band, there is no reason to believe that any compromises were made. Indeed, the performance specifications (shown in Table 1) bear this out. The specs are as good as (and in some cases, better than) specs from Kenwood's much larger single band radios.

"I have never experienced problems with desense or squelch breaking when transmitting on one band while listening to the other."

In Use

For several months now, the TM-621A has been installed in the headliner of my 1976 Ford van. Separate ⅝-wave Larsen antennas are mounted about six feet apart on the roof. I have never experienced problems with desense or squelch breaking when transmitting on one band while listening to the other.

Surprisingly, the mounting bracket is simply attached to the radio with four screws. This isn't a problem for permanent in-dash installations, but when the radio is mounted under a dash, the slip-in locking bracket that Kenwood provides with many of its other mobile transceivers would be a better choice. It would allow the radio to be more easily removed for security.

The amber display was readable under all conditions—even bright sunlight. The front panel controls are reasonably well-lighted, which is fortunate. I counted no less than 22 switches and controls, nine of which are mounted in a straight line across the front panel. Unless you are very talented, operating this radio by touch alone is not something that will come easily. After a few days of use, I was able to operate frequently-accessed controls like the BAND, AMC, VFO and MR/M switches by touch. Even after several months of use, I find it necessary to look at the front panel to operate controls like SHIFT, SCAN, and MUTE.

In my noisy van, audio performance from the tiny internal speaker was inadequate. Connecting two external 5¼" speakers solved the problem, providing more than enough punchy, intelligible audio under any conditions.

Basic RF performance was superb. I made no attempt to confirm the manufacturer's claimed specifications, I did carefully examine real-world performance. I compared the 2 meter section to the ICOM IC-28H, and the 220 MHz section to the Kenwood TM-3530A. In all cases, the TM-621A matched or out-performed the specific units in my possession.

I often commute along a stretch of highway that is bombarded with severe leakage from the cable TV service that runs parallel to the road. Several radios I have owned or borrowed suffer ill effects, including desense and squelch breaking. The TM-621A completely ignored the problem. I noticed similar improvements in intermod rejection during my frequent visits to the RF-laden cities of Boston and Cambridge.

Out-of-band receiver performance was excellent. I frequently listen to NOAA weather broadcasts, and the TM-621A is significantly more sensitive than earlier generation extended coverage radios.

Conclusions

If you have any interest in 220 MHz, the TM-621A deserves your attention. It is an ideal radio for Novices; you can operate 220 MHz now, and when you upgrade you can immediately begin using 2 meters without buying yet another radio. Hams with higher class tickets will appreciate the full duplex capabilities and the many features designed to make it easier to use to use two bands simultaneously.

The TM-621A is not inexpensive, and with a little shopping around you might be able to find separate 2 meter and 220 MHz rigs that together are slightly less expensive. But you'd be missing the many useful features that make a dual-band radio a much more convenient choice. Unless you buy radios by the pound, and like the idea of having two microphones constantly getting tangled up together, the TM-621A's superb performance, unique features and compact size make it a radio worthy of serious consideration.

WA6TEY 144/220 MHz RDF Quad Antenna

T-Hunters take note! Here's a simple project that gives you a highly directional gain VHF RDF antenna.

by Dr."Kuby" Kubichek N6JSX

The TEY Quad antenna has no capacitance or inductive matching networks. Matching networks cut down the efficiency of the antenna by adding more electrical components into the RF line. Major physical distinctions of this quad design from other designs are:

1. The Bazooka balun (an RF choke).
2. The diamond shape, which is sturdy and easy to construct.
3. The use of discarded TV antennas.
4. Versatility. By dropping all 220 references, you can construct a 2 meter monobander.

Compared to a yagi, the WA6TEY Quad antenna is small. It is lightweight, with low wind loading, and has good directivity. It's easy to build, and inexpensive, costing about ten dollars in materials.

Gain is about 6 dB for the 4-element quad. It has a full-wavelength driver, a true 50Ω load with no capacitive or inductive matching devices, and it is broad-banded with low VSWR across the band. The front-to-back ratio is good, with an average of more than 4 S-units difference.

Great for T-Hunting

About 60% of the mobile direction finders or T-hunters in the Los Angeles area use the 2 meter, 4-element version quad. Quads are used by T-hunters because they have the most gain for their size and they exhibit directivity no matter what the polarizations of the radiated signal are.

Promise Fulfilled

This quad was designed by Ray Frost WA6TEY, a pioneer of VHF quad designs, and a renowned T- and jammer-hunter. At our last meeting in August 1985, Ray asked me not let his quad design die with him. In September, Ray became a Silent Key after a hard fight with cancer. He had built an estimated 300 base 2 meter quads in single and paired configurations. The most notable of Ray's designs is the Mobile Direction Finding Quad. Ray gave them all to promising new amateurs in Southern California, never asking for, nor accepting, any remuneration for his quads. Ray only asked that the quad recipient "be a GOOD amateur."

Just before Ray passed away, he gave me all his antenna design notes and reference materials and told me to expand them. Ray was one of the prime authors that spearheaded the successful passage of Public Law 97-259. This law allows the FCC to enlist the assistance of amateurs for monitoring the bands for rule violations and for gathering evidence. I was truly fortunate to be Ray's last T-hunting partner, as he was an outstanding teacher of the HUNT. Ray was revered as one of the best hunters during his time, and many people will surely miss him.

> *". . . a change in polarization can make quite a difference in the S-meter level."*

The History of the WA6TEY Quad Antenna

The goal of this antenna was to allow directable 220 HT communication. This would minimize overheard communications between cooperating hunters when they arc exchanging information concerning strategies for nailing an illegal signal. At the time this antenna was designed, most of the amateur community was rock-bound and avoiding the 220 band due to this equipment restriction.

The most obvious physical feature of this quad is the reverse spacing between elements. This design was an experiment by Ray to see if he could obtain good directivity, match, and usability of the 220 band. But the surprising trade off to the 2 meter side of this antenna proved to be a real improvement to the 2 meter T-hunting capability. True, the gain of the 2 meter antenna was reduced slightly, but the front-to-back ratio was increased. The really big plus was the reduction of side lobes and thus the enhancement of a very dominant directive frontal lobe. The advantages are clear in the world of mobile flutter and the need for speedy good directive resolution.

Polarization Makes a Difference

The feedpoint of the antenna determines the polarization characteristics of the antenna. On a diamond-shaped quad, the feedpoint on either end of the horizontal spreaders will give the antenna vertical polarization. Putting the feedpoint on the vertical spreader will give horizontal characteristics.

Another technique commonly used for quick polarization changes is the construction of the boom and mast with PVC and PVC "T" section. This allows free ninety degree or less rotation of the quad for polarization change. This is important because a change in polarization can make quite a difference in the S-meter level. It will also often indicate a very definite peak on the meter. This allows you to make a more refined and accurate beam bearing. This polarization comparison technique can also give some insight as to multipath and reflections being seen. Most multipath and reflections are usually some other polarization, than that of the actual transmitting antenna. When the antenna is in an opposite polarization configuration, the signal may appear to have a broad peak on the S-meter—as much as twenty-five degrees.

Considerations Before Building

The more metal on the spreaders, the less dowel to treat. This is important to remember, especially in Southern California, where the heat, wind, rain, and smog, weather antennas quickly.

Before construction, decide if the permanent mast is to be metal (conductive) or plastic/wood (non-conductive). Be sure to use the the appropriate mast when tuning so that you will make the proper compensations.

If you decide to use PVC with a center

73 Review *by Tom Guntzel KE0KB*

Aries-1

Deluxe RTTY logging program.

Ashton ITC
PO Box 1067
Vestal NY 13851
PH: (607) 748-9028
Price Class: $90

Consider me an ardent RTTY enthusiast. Having recently upgraded my computer equipment to a PC compatible and my TU to a PK-232, I was anxious to find a software package that would take full advantage of both.

Searching the ads of various publications led me to a program called Aries-1. The ad touted the software's ability to insert the time and date (from the computer) and the frequency and mode (from the transceiver if properly interfaced) into a real time logging program. It would also operate in a special contest mode which would automatically check for dupes as well as allow for abbreviated log entries. All this while supporting all the operating functions of a PK-232 or KAM. Additionally, the program would allow the user to enter data into the logger and control all functions with a mouse as well as with the keyboard. The Aries package had the features I was looking for, and it quickly became a new addition to my software library.

Quick Startup

After a quick look at the well-written manual, I had the software up and running. I found that modes could be quickly changed with a function key or mouse click and that the default values built into the program were adequate for normal operation (they can be changed with the addition of a special file on the program disk). While not spending a lot of time in the CW, AMTOR, or packet modes, I did verify that they operate as expected. Checking into a local packet BBS was as easy as a mouse click away. Aries shines brightly on the RTTY bands and has all the features necessary to make operation simple and enjoyable.

Using the Program

The top few lines of the screen contain the fields that can be filled in when using the logging program. The data can be entered from the keyboard or the mouse. As soon as a station's call is entered into the ID field, a check is made of the log for a similar entry. If a match is found the information from the most recent matching entry is put onto the screen. This process takes only a few seconds because the complete log base is in memory at all times. As the QSO progresses all fields in the logger can be filled in and, when ready, a single command writes the log information to disk.

While in the normal mode, writing the log data to disk erases all the data fields, preparing the logger for the next entry. In the contest mode, the logger behaves differently. Fields that would not normally change (mode, band, power, RST, etc.) are not erased after being written to disk. This makes contest logging an easy task.

The use of a mouse shortens the number of keystrokes required to fill in the fields in the logger. In fact, it's possible to have a complete QSO or contest exchange, depending on how your buffers are loaded, without having to type in any information. If you point the mouse cursor to the field that you want data entered into, and then click the mouse after that data has been received and is on your screen, the data automatically goes into the log. As soon as a call is entered into the ID field, a dupe check is initiated. The call is also put into the call exchange buffer. This way, when the F4 key is pushed, the station you are working and your call are automatically sent. The ability to use a mouse is an important and unique feature of the Aries-1 software. It makes contest operating a real ease and day-to-day operation a snap.

> ***"(With a mouse), it's possible to have a complete QSO or contest exchange . . . without having to type in any information."***

Practice Makes Perfect

The technique needed to click the mouse at the right time to get the data you want entered into the logger takes a little practice. The mouse must be clicked after the data you want to enter is on the screen and a space has occurred, but before the next space occurs. In other words, when the mouse is clicked, the most recent letters between spaces are entered into the field you have selected.

Another useful function in the Aries-1 is what the authors call "replaceable string parameters." Using them lets you customize your stored buffers in a way that would make them seem as if you are entering them from the keyboard. For instance, one of the replaceable parameters is for the "Name" field in the logger. If you have a buffer stored that has the control code for "Name" in the proper place and you have entered a name in that field of the log, when that buffer is transmitted, the name is inserted in the proper place.

The log entry number is also a replaceable string parameter. During a contest you can have an automatically incrementing QSO number both for your log functions and to transmit as part of your exchange.

Log Management

The software also operates in a manual mode allowing you to use it as a logger alone. This feature enables you to use the package as your station logger regardless of the mode you are operating. Previously mentioned fields are supported in the manual mode. Additionally, the remainder of the screen becomes a scratch pad—anything typed will appear on the screen, a handy feature for CW QSOs.

The versatility of the log management module is hard to equal in other on-line logging programs. You can search the logs and create new logs with the results. You can change or delete records, and print logs in long or short form. These are just a few of the program's features. The log management section is also capable of creating outputs that are dBASE III compatible.

The original version of Aries that I received had a few faults in both the software and the manual. Most of those have since been corrected. Remaining shortcomings are the absence of a QSO buffer (one is promised in an upcoming version) and the inability of the contest logger to do any type of scorekeeping.

My station equipment consists of a Leading Edge D2 computer with a monochrome monitor, and an ICOM 751A which is not interfaced to the computer. Thus, I'm not able to comment on the appearance of the screen in color nor the part of the software that imports data from the radio. Ashton is currently working on expanding that portion of the software to include more control of the radio and additional memories.

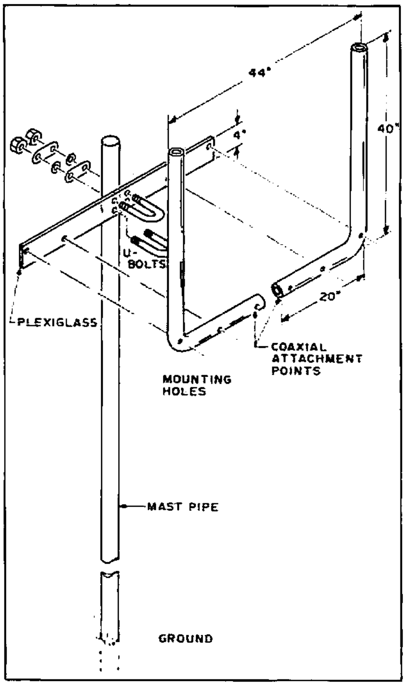
Ashton's president is Tom Ashton NY2I. I have spoken with him several times and he is very interested on feedback concerning his product. He continues to update his software. Revisions are free during the first ninety days, and available at reduced rates thereafter.

During a recent RTTY contest I used this software to make and log over 300 QSOs. It performed flawlessly, is easy to use and lives up to its advertising claims 100 percent. It has been a welcome addition to my software collection.

Slingshot for Two

Big 2-meter signal for under $5.

by David Younker KA8OGD



Assembly of the 2-meter "Sling-shot" antenna.

I would like to be able to say that I ran a ream of calculations through my IBM PC to arrive at the design for this antenna, but I cannot. I used an abacus.

Actually, I was considering building an expanded quad loop—two wavelengths long but open at the top center. My friend and coworker Henry Higgins (an SWLer) suggested, however, that by reducing each element for ¼-wave, I could do without the matching network.

He was right. The radiation pattern changes, however, from bi-directional broadside to the loop to bi-directional in the plane of the vertical elements.

Construction Procedure

To build the two meter version, obtain a length of electrical conduit ten feet long. Cut the conduit in half and bend each length into the shape of an "L" with 20 inches on the short side and 40 inches on the long side. Have a person from the hardware store do the bending for you, or you may end up with collapsed bends, as I did.

Drill mounting holes as diagrammed, or work out your own arrangement. I bolted the antenna to a piece of Plexiglas™, but a length of painted wood will serve as well. Next, attach the antenna to the mast with a pair of muffler clamps. Then, attach the coax and operate.

Results

SWR on the sling-shot, untrimmed, is 1.5:1 across the top two MHz of the band. I get reliable coverage over a forty mile radius of the home base. Limited experimentation with a six meter version with KD8FW on the receiving end some sixty miles away gave better results than my two element beam at thirty feet (for operation on 2m).

With both the six and two meter versions, the horizontal section was a half wave or more above ground level. I have not tried any other elevations and will not until I put up the 15/10 meter job that I have planned for the summer. Fifteen meters would appear to be the upper limit for this design—after fifteen the dimensions begin to get unwieldy.

Total cost for the two meter version was under five bucks—$3.60 for the conduit and $1.30 for the muffler clamps. I already had the Plexiglas in the junk box.

My thanks for Charles Woods for his assistance with the diagram.

FM Split for the Uniden HR2510

Modify this rig for easy 10m repeater operation!

by Richard Thomas WB9WDH and Thomas Dick WA9QDZ

In addition to surplus CBs that are easily modified for ten meter operation, there are many new quality inexpensive ten meter FM radios now on the market. One of the best examples of these new rigs is Uniden's President Model radio. It operates in AM, SSB, FM, and CW modes. It sells for about one third the cost of a regular ham-band transceiver. Its one notable drawback, however, is that its FM operation is not designed for the split frequency operation necessary for repeater operation. This article shows you how to modify the Uniden for easy split frequency operation.

Circuit Workings

Uniden opted to use one filter for receive and transmit, using switching diodes to go from one state to the other. Receive is turned on in all modes except FM with the diode D105. In the transmit mode, D105 is turned off and diodes D106, D120, and D109 are biased on, effectively isolating the filter (FT102) from the receive circuit and using it to filter SSB and AM transmit audio. In FM operation, no audio is passed through this filter. All this action takes place on the main board of the Uniden.

On the original model, modulation is done in the VCO on the microprocessor board. D1 and D2 of the new bypass filter that

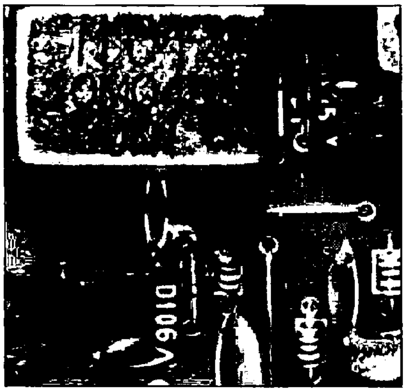


Photo A. Installation of the bypass section of the mod on the main board of the Uniden.

we use (Figure 1) turn on through radio parts R11, R18 and R13. RF flows through D1, C1, and D2 around the filter. DC passes through R1 and R2 of the bypass network to an 8 volt transmit source via the beep switch. The 10.6975 MHz frequency is passed through to the transmit mixer

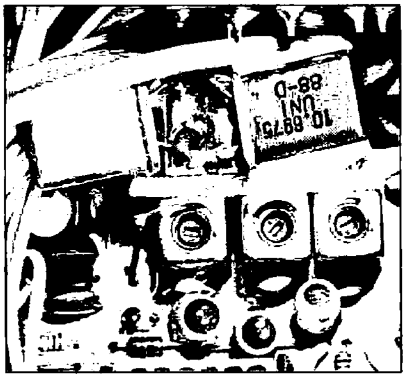


Photo B. Installation of the crystal and the relay. This is at the front of the Uniden, the left side as you face the rig.

to derive the operating frequency.

In order to get the offset for repeater operation, we chose to change back and forth between the regular crystal at X101 (10.6975 MHz) and the new one (10.7975 MHz). The crystal shift is done with relay K1 and X101A (10.6975 MHz) and X101B (10.7975 MHz). X101B is 100 kHz higher, so when it is mixed in the transmit mixer, the difference in output is 100 kHz lower than the original crystal at the operating frequency. The K1 relay power is taken from the FM mode switch wire (brown wire) so that the relay is turned off in all modes except FM. This allows the relay to be energized when the beep switch is in the IN position, making offset operation possible. Take note that the beep switch must be in the OUT position for operation on SSB and AM. The OUT position also shuts off the offset crystal X101B for simplex operation on FM. The beep feature will be eliminated.

Before you try to modify the Uniden President, make sure it transmits and receives on the same frequency. This is called tracking. You can check for this problem on the air but be sure the RIT knob is absolutely vertical. If it does not transmit and receive on the same frequency, return it to Uniden for repair before making any modifications.

It takes very little to make the necessary changes: one crystal for 10.797.5 MHz, one subminiature DPDT DIP relay from Radio Shack (part #275-213A), and several resistors and ceramic capacitors. Total cost for all items should run less than $20. For another $15.75 plus postage you can get a service manual (part #SMHR2510) from Uniden (Sales Dept., 9319 Castelgate Dr., Indianapolis IN 46256). Let's take this modification step by step.

Dramatis Personae

First, order a crystal for 10.7975 MHz fitting the characteristics of a crystal for the Cybernet board (holder HC 18, PT#/OF = RMF-9, R.T. Tol. = 50 CL PF + 30 RS = 20). You can order the crystal from Crystek Corporation (PO Box 06135, Ft Myers FL 33906, PH: 800-237-3061.) While you are waiting, go to Radio Shack and get one relay (Radio Shack part #275-213A) plus any of the other parts you don't have around the ham shack (see Figure 1).

Build The Bypass

When the crystal comes you are ready to go to work. Disconnect the power cord from the rig. Remove the top and bottom covers by taking out the screws. Be sure that you don't have anything around the work area that could short out against components in the chassis. Build the bypass network as found in Figure 1 between D106 and D120 near FT102 (see Photo A). Make the leads between components as short as possible. Attach one wire about 8" long to the junction of R1/R2/C1. Connect the power cord and turn the radio on. Try to receive and transmit on SSB. If you wired everything correctly the radio should work. If it doesn't, don't proceed until you have cleared up the mistake.

Beep Switch Mod

Turn the radio off and unplug the power cord. We are going to modify the beep switch at this time. Locate the beep switch on the front panel of the radio. This will keep you properly oriented. Now remove the four

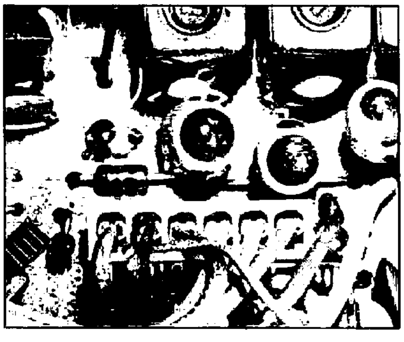


Photo C. Plug from the mode switch. The wire from pin 16 of the newly installed relay runs to the brown wire of this plug.

:rews in the side of the face plate. This will low the face of the rig to fall away. Pull down as far as possible. Locate the back f the beep switch (Figures 2 and 3) and olate all six landings of the switch by cutting ie three trace runs with a sharp knife (see igure 3). Brighten the copper foil around ie switch landings so that it will take solder. repare four pieces of wire ten inches long, referably in four different colors. Solder wire to each of four landings: B1, B2, C1, : C2. Put the face of the rig back on. Insert ie screws. Reattach the power cord and turn ie rig on. The rig should still work on all iodes.

Relay/Crystal Mod

Now turn off and disconnect the power ord again. Turn the rig upside down and ocate the VCO assembly, which hides the older leads for crystal X101. Remove the vires attached to VCO assembly. (Be sure to iote where they go so that you can put them back.) Remove the whole VCO assembly and hen unsolder crystal X101.

Turn the radio over on the other side. Mount the Radio Shack relay against the netal sides of the cans for L116, L118, and L117 (Photo B) using double-sided tape with he pins of the relay pointing away from the board and pins 1 and 16 facing toward the outside edge of board. Connect a wire from pin 13 of the relay to the empty hole of X101 that is farthest from the front of the rig. Connect a wire from pin 4 of the relay to the empty pin hole of X101 that is nearest to the front of the radio. Now replace the VCO assembly.

Next, connect a wire from pin 16 of relay to the brown wire of the plug from the mode switch. This plug is in the area of X101 in the left front corner of the main board (see Photo C). Connect a wire from C2 of the beep switch to pin 1 of the relay. Connect a wire from B2 of the beep switch to any good chassis ground. Connect a wire from B1 of the beep switch to resistor R93 on the side next to FT102 (Photo D). Connect wire C1 of the beep switch to the wire that is attached to the common junction of R1/R2/C1. Make the joined wires as short as possible and tape the solder connection carefully. Then solder the crystal removed from X101 to pins 11 and 6 of the relay. Solder the new crystal to relay pins 9 and 8, being careful not to short out any of the leads to the case.

Mod Checkout

Attach the power cord and turn on the rig. Check the voltage on the relay to see that it turns on and off when the beep switch is depressed and out. Set the LED readout for 29.000 MHz of your Uniden. With the beep switch out and the radio in the FM mode, key the transmitter and read the transmit frequency with a counter. It should be within 1 kHz or less of what the LED readout on the radio shows. If it isn't, you have made a mistake. Go back and check your work carefully.

If the transmit frequency is not the same as that indicated by the readout (but within 1 kHz), adjust L117 to obtain the same frequency as that displayed by the LED readout. Put the radio in lower side band (LSB) mode. Set the RIT in the dead center position, i.e. the vertical or the 12 o'clock position. Generate a signal with a 100 kHz generator like that found in older analog ham receivers. Bring the radio close enough that the signal can be heard in your Uniden radio. Zero beat the Uniden radio with this signal using L118. It should take no more than one turn. Then change the rig to upper side band (USB) mode. Zero beat again using L116. This reestablishes receiver tracking.

That concludes the modification of the radio. Replace its covers. The beep switch must be out to transmit on AM or Side Band, and for FM simplex. The beep switch should be depressed when you want to transmit on the offset frequency characteristic of ten meter repeaters.

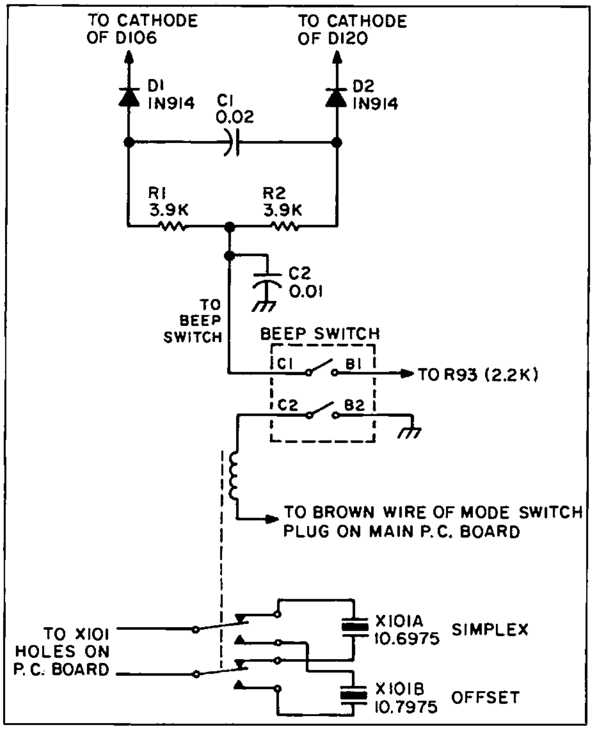


Figure 1. Schematic for the modification to the Uniden President 10m rig for easy repeater operation.

Postscript

We suggest one additional modification for the operator who switches from one mode to another frequently and may forget to reset the beep switch. The installation of an additional relay identical to the one already used will help to reduce the chance of operator error for the true purist. It disables the bypass function when the mode switch is in any position other than FM. The relay coil for this new relay should be connected in parallel to the other relay coil that switches the X101 crystals. You can use either pair of normally open contacts of this relay. They should be connected in series with the power lead that runs from the bypass network to the beep switch. The mounting of this relay is not critical.

Here's hoping to satisfy all those 10 FM repeater users out there who wanted to buy this fine and inexpensive radio, but held off because there was no easy split operation on it. Now there is—

Enjoy!

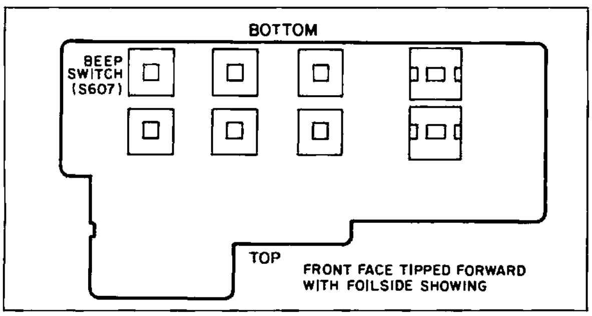


Figure 2. Board in the Uniden toward the front panel, on which the beep switch sits.

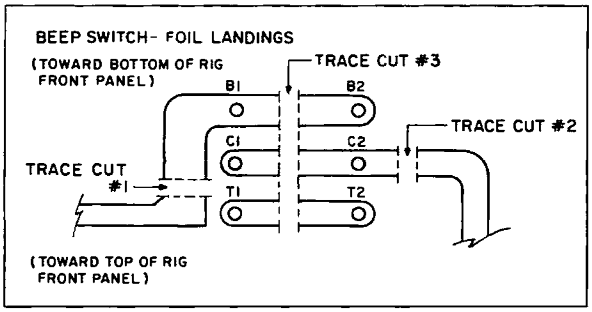


Figure 3. Close-up of the foil landings for the beep switch. You need to cut three traces to modify this switch to have it switch on and off the split feature.

Number 13 on your Feedback card

73 Review

by Alan C. Merrill W1FYR

Delta Loop Antennas, Inc.
12 Brush Drive
New Fairfield, CT 06812
Price Class: $300

The Delta Loop DL-102

Take advantage of the versatile 10-meter band.

A seven foot box arrived by UPS one sunny fall afternoon. "Ha!" said I, "My new 10 meter Delta Loop beam!" Hearing this, my XYL said, "What, another antenna? You already have ten, how come you need another one?" I said, "M'love, you grossly exaggerate!" (I really only have nine.) "But this is special. . ." And at the time, I really did not know how true that statement was.

Mil-Spec

The thing that impressed me the most upon opening the box was the overall high quality of the unit. This antenna is built to last. As I continued to build the unit, this fact became even more obvious. For example, all of the tubing is 6061-T6 aluminum. There are no castings, and all the hardware is mil-spec stainless steel. This is perhaps to be expected, as Bob Hobert KA1UJ, the President of Delta Loop Antennas, Inc., has a great deal of experience in building aircraft and missile parts.

The Delta Loop

What is the DL-102? By definition, it is a V-shaped beam, commonly called the Delta Loop, with the element tips connected together with copper wire. The boom supports the "arms (elements)." The Delta Loop is not a new idea. The 1970 edition of the *ARRL Antenna Book* discusses it in some detail, giving dimensions for a number of the HF bands.

In this version, the elements are attached to the boom (5' long) by heliarc welded element "horn" clamps. A mast mounting bracket attaches the boom to the supporting mast. The manufacturer recommends using 1½" ID galvanized water pipe for the mast, and the bracket is designed to accept this.

The bracket also has two sets of holes drilled to allow U-bolt mounting if you don't want to go with the 2" OD water pipe. That 2" OD water pipe is great stuff, but it is heavy. I will probably use it on my permanent installation as it is reasonably priced and generally available at plumbing stores.

The antenna exhibits the same general broadband characteristics and electrical properties as full-wave loop antennas such as the quad. Some of the other interesting specifications are weight: 21 lbs., element arm length: 12 ft., boom length: 5 ft., turning radius: 7 ft., surface area: 2.9 sq. ft., and element spacing: ⅛ wavelength. It also has an adjustable gamma match with a rating of 2 kW, a 50Ω input impedance, and an SWR at resonance of 1.1:1. The gamma match is factory pretuned and wired. All you need to do is connect your coax to the bracket.

Tunerless Operation

The factory setting was just about right for my location. My solid state rig liked much of the 10-meter band, with the protective SWR circuit only shutting it down on the last 500 kHz of the upper band edge. On the lower end, at 28.000, we saw only 1.6 to 1. At 28.200, we were looking at an SWR of 1.2 to 1. From 28.200 to 28.700 it was a nice 1.1 to 1. At 29.000 it was 1.6 to 1. I suspect most solid state rigs would handle a large part of the 10 meter band without an antenna tuner. My older Kenwood 820S with a tube final took the entire band in stride.

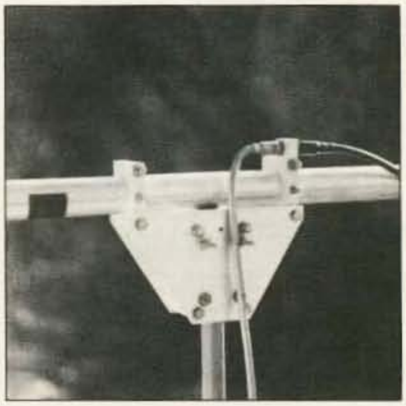


Photo A. The five-foot boom and mast mounting bracket, showing the clamp for the coax and the overall sturdy construction.

Full wave antennas are supposed to be broadband, and this one certainly is. The gamma is easily adjustable, so you can favor one end of the band or the other, and the way to do this is clearly spelled out in the instructions.

Performance

An antenna can look like a million bucks but unless it performs for you, you might as well go back to a wire dipole. As a quick comparison, the DL-102 outperformed my tribander, which is up a lot higher. And, of course, it left a ground-mounted vertical in the dust. The Delta Loop consistently gave us about two to three S-units over the tribander on both transmit and receive.

The first call I gave on ten meter AMTOR brought a W6 back to me with a 589 report. On the next call on AMTOR I found a W7 maritime mobile in the area of Colon, Panama. We had a great chat for about an hour. All this when ten was only marginally open! My subsequent experiences with this great antenna were no less satisfying.

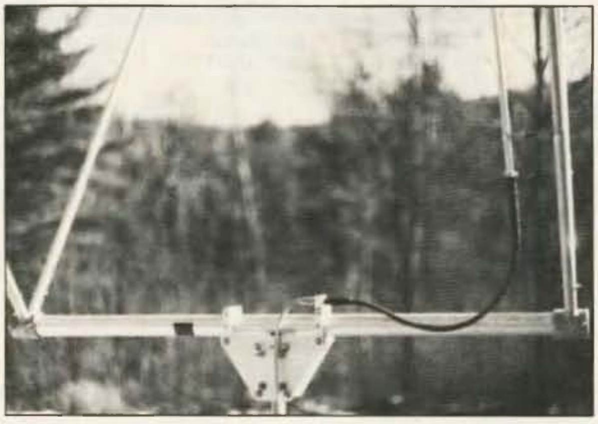


Photo B. The boom, with the heliarc welded, heat treated, element "horn" clamps that support the "V" arms. The black cable connects between the coax support and the gamma match, which is prewired.

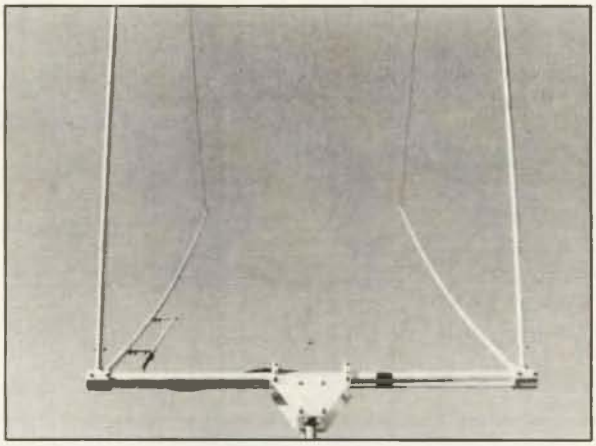


Photo C. The full antenna showing the elements and the copper wire connecting the upper end of the elements.

How about back-to-front? It is a two-element beam. From all I could see, it performed as well as or better than most of its horizontal-element ilk. Though S-meters at best give you a rough comparison, I was happy to see several S-units difference as the beam was swung 180 degrees. As the null on the side of the beam was reached, I just about lost the weaker signals, and others dropped several S-units, all of which was about what I expected from a beam with a driven element and a reflector. Typical performance for well-designed loop antennas should be 6 to 7 dB forward gain, and a front-to-back of around 20 dB. Any given field situation may show a vast difference from these "typical" figures. Gain figures are rather illusive and, unfortunately, can be made to say most anything you want them to, depending upon how you measure them. The bottom line is that the old saw about "the proof of the puddin' is in the eatin" certainly holds here. The "eatin" was good!

Withstands the Elements

The Delta Loop has weathered several ice storms here in southern New Hampshire, and has come through them with flying colors. I suspect that, because of the "V" shape of the elements, this beam's ability to withstand rotten weather is probably very good to excellent. Another nice feature of the DL-102 is that it has a surface area of only 2.9 square feet, which means it can be rotated by a good TV rotator or by a lightweight ham unit such as the Alliance U-110.

A Picture Says 1000 Words

My only complaint was with the instruction sheet. The pictures of the beam for construction purposes were not good—it was difficult to see many details. Being a visual type person rather than a verbal type, at least in putting things together, I found this annoying. Also, a sheet with line drawings of the various parts, with labels, would have made things easier. Nevertheless, it is a very easy beam to put together and the written instructions were very complete, so this complaint is certainly a minor one. In a recent conversation with the President of Delta Loop Antennas, Inc., I was advised that the new printing of the instruction sheet will correct the photograph problem.

One very nice thing about the beam was the machining. All parts fit perfectly! I did not have to re-drill or re-bore any holes. I probably spent a little over two hours, with time out for coffee breaks, telephone calls, and chats with my XYL.

During the next several years, as Solar Cycle 22 peaks and then begins to wane, 10 meters is going to be a great band to work, with its variety of legal modes. I remember past solar cycle peaks when we were routinely "working the world" on 10 meters and running relatively low power. Don't miss out on the fun!

An A1 Antenna

To sum it all up, if you are serious about ten meters, this is the beam for you. And from the way it is built, it should last well into Solar Cycle 25!

73 Review by Jim Gray W1XU

Austin Suburban Tribander

Austin Custom Antenna
PO Box 357
Tenney Road
Sandown NH 03873
(603) 887-2926
Price Class: $70

High performance from 2m to 70cm.

How would you like a slim, small, easily-erected antenna that covers the three most-used VHF/UHF bands? The Austin Custom Antenna "Suburban Tribander" may be exactly what you've been looking for, if you haven't already found it.

This unique antenna covers the 2 meter, 223 MHz, and 440 MHz amateur bands with a very low VSWR. The Tribander covers these three bands with a single feedline of 50Ω characteristic impedance. Obviously, if you have three separate radios, you will have to use a coaxial switch to select the radio you intend to use. A better arrangement might be one of the new duo-banders covering these two bands. Those of you who may still have the Drake VHF-UHF triband rigs available will find this antenna ideal.

"(The antenna) can be easily removed, yet will never come loose by itself."

The Suburban Tribander is vertically polarized and consists of half-wavelength radiating elements protected by an attractive "radome" of PVC plastic. The dimensions are such that you can use it either for a fixed station installation or on your automobile, since it measures less than four feet in length and less than an inch and a half in diameter. The weight is negligible. The antenna is a civilian version of similar antennas designed for military and government use, and has the desirable features of simple, economical mounting and excellent weather protection.

One feature I've never seen before is the tapered "sleeve" mounting system used here. There is a two-foot-long stainless steel mounting tube inside which the base of the antenna makes a sliding fit. It can be easily removed, yet will never come loose by itself. The sleeve can be bracketed to your support pole by either U-bolts or by hose clamps (as in my case), or even by a pair of angle pieces welded back-to-back along their angles.

Form An Attachment

Austin will supply mounting hardware if you need it, including bumper mounts with stainless steel straps, ratchet lay down for marine antennas, bulkhead stand off for marine antennas, and stainless steel scroll clamps. In addition, you can order a magnetic mount fitted with an SO-239 and Motorola Type ¾" thru hole SO-239 fitting, a male quick disconnect stud for 500SS/FG series mounts, and a large male quick disconnect for the "stick." Austin also provides a variety of low-loss cables.

The Suburban Tribander is a ground-independent antenna on all three bands, and provides an angle of radiation of 1 degree or less above the horizon. The VSWR was less than 1.35:1 on all bands, measured at the center frequency. The mobile version, called the Metropolitan, uses the vehicle body for decoupling, and a 4 MHz bandwidth is achieved on all bands. Its performance equals or exceeds that of a half-wave dipole.

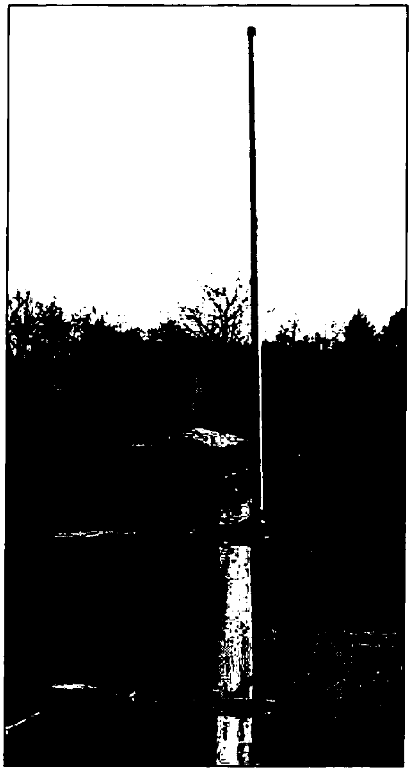
Shack Test

I mounted the Suburban Triband antenna at the top of a 30 foot telescoping TV type mast, using a pair of hose clamps to secure it near the top. No pretuning was required. I connected a long piece of RG-58 cable that happened to be handy and had been used for other antennas I've used in the past. Unfortunately, I didn't have a 220 MHz rig to try that band, but I can certainly vouch for its fine performance on both 440 MHz and 2 meters.

The antenna support is nearly surrounded by pines rising to 60 feet or more. In addition to that, my QTH is approximately 75 miles to the test repeater, one which covers both bands.

Although my elevation is about 5,000 feet above sea level, there are nearby mountains rising to 7,000 or more feet ASL, some of which block the antenna in the directions that I want to use. Not to worry. The Surburban Tribander was able to bring up both the 147.36 machine's and the 444.5 machine's full quieting into the receiver—this with a transmit power as low as 2 Watts!

I then tried the impossible—or so I thought—by tuning to the input of a repeater behind the mountains and 100 miles distant. To my surprise, I brought it up with no difficulty on 2 meters (scratchy reception) though not at all on 440 MHz. That didn't surprise or discourage me in the least, as I need an 11-element beam to provide solid signals to and from that location.



The Austin Suburban Tribander 2m/1.25m/70cm antenna.

Go For It

Do I recommend this antenna? You bet! The Suburban Tribander is a simple, high-performance antenna that will yield excellent performance for years to come.

Continued from p. 14

tion for protection against corrosive atmospheres, such as air containing salt and industrial pollutants.

The 28 MHz operation could be improved by further "pruning" of the helically wound portion to achieve a low VSWR at resonance, and at the 50-foot elevation. This is something to take into account at installation. Resonant frequency at 28 MHz may vary by as much as 100–200 kHz between ground adjustment and elevated installation, particularly as inductively-loaded whips (such as the short, helically-wound antenna) have typically narrow bandwidths around their determined center frequencies. For narrowband antennas, height makes a very big difference in resonant frequency. Of course, the discone itself, without the vertical whip, needs no tuning or pruning whatsoever.

The Verdict

Hams, CBers, law enforcement agencies, utility stations, businesses, and military groups will find the Supercone a very useful antenna. The Supercone is an attractive and useful adjunct to any station particularly interested in covering the VHF and UHF portions of the radio frequency spectrum. We believe it performs satisfactorily over a wide band of frequencies for both transmitting and receiving in the VHF/UHF bands up to 1.3 GHz. The price of the Supercone, which includes a whip antenna for 28 MHz, is reasonable, considering the antenna's light weight, rugged construction, small size, low end-loading, and overall performance.

73 Review

by Peter Ferrand WB2QLL

The Universal M-7000

Decodes all standard digital modes—and then some.

Universal Radio
1280 Aida Drive
Reynoldsburg OH 43068
PH: (614) 866-4267
Price Class: $1,000

Photo A. Fore…

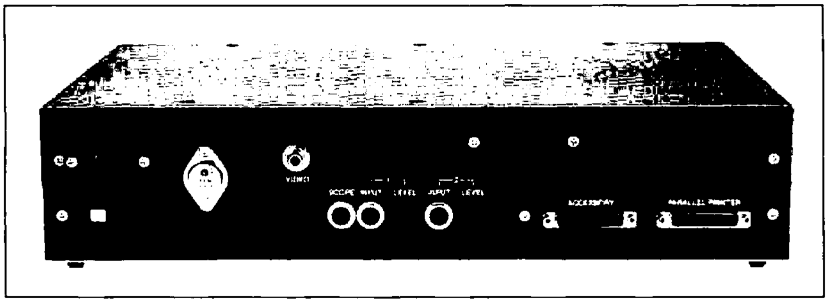


Photo B. …and aft of the M-7000.

Part of the magic of radio has always been exploring the frequency spectrum, just turning the dial and not knowing what you will hear next, or from where in the world it will come. it's the magic of seeking out new knowledge, and the challenge of a hunt requiring luck, skill, and perseverance. The result is a fascination with amateur radio that began for many of us as a kid playing with a shortwave receiver.

The Spirit of Challenge

You won't find much of that spirit with a 2 meter HT, and digital radios and million Watt transmitters have made most shortwave broadcasting mundane, but the spirit of challenge and discovery comes to life with the Universal M-7000.

The M-7000 is a communications terminal capable of receiving almost any standard digital mode on the air, including several that you have probably never heard of (see Figure 1).

You won't be able to make sense out of all the noises on the dial, for many are encrypted, and many more are not text or pictures, but if you're fascinated with finding new stations, the M-7000 has ample tools to pick out almost any signal. You can display Russian text in Cyrillic, nonprinting RTTY codes, such as line feeds, and if all else fails, you can display signals in binary (yes, with ones and zeros on the screen).

Stations around the world available with the M-7000 include marine and diplomatic traffic, news services, facsimile weather and news photos, military communications, and of course, amateur radio.

One of a Kind

The M-7000 is the only machine available that combines all these modes. Fred Osterman, the owner of Universal Radio, says that commercial and military users constitute many of the buyers of the M-7000. The M-7000 is ideally suited for training operators in varied modes.

The M-7000 combines the features of several previous DES units into one unit with added functions, while maintaining the same overall design and operational philosophy. I have owned half a dozen of the previous units, and

> **"Diversity reception is a unique feature of the M-7000."**

the M-7000 represents a step forward in all respects.

The complexity presented by two 16-button keyboards and an array of lights and switches is a consequence of the designers' decision to allow the operator as much flexibility as possible. Each of the buttons on the keypad is dedicated to two functions, one normal and the other shifted, controlled by a shift toggle switch on the front panel.

Other functions are controlled by other toggle switches, and LEDs provide information on signal strength, decoding, and errors. A program mode allows you to change system constants, such as interfacing, printer parameters, selective calling, and memories, as well as diagnostics and calibration.

Complete Documentation

All of this is very well explained by the two manuals that come with the M-7000. The first is "Getting Started," written by Osterman. The other is a reference manual so complete it even has schematics and alignment instruction (Hooray!). A reference card is included (see Figure 2), and that information is duplicated on the help screen.

The manuals confirm that those who are unwilling to read them will not be able to take advantage of the M-7000's versatility. Even so, it only takes a few minutes with the "Getting Started" manual for you to begin receiving digital transmissions. Once the unit has been set up for a particular signal, the setup can be repeated the next time.

Getting Started

There are two time-consuming aspects to operating the M-7000, and both are a reflection of the hobby itself. First, in order to use all the control functions, you need at least a rudimentary understanding of the principles behind the mode you are trying to copy. Sufficient information is in the manuals, but it takes some experience, too.

The second aspect involves the nature of the transmissions. The "Getting Started" manual provides a terrific head start by listing frequencies and mode settings for an assortment of stations transmitting in all the modes the M-7000 is capable of receiving. In theory, all you have to do is set up your receiver and let the M-7000 soak up all the neat information. But frequency and mode listings aren't enough. Most of the transmissions are directional for point-to-point services, and frequen-

SPECIFICATIONS	
Modes & Speeds	
ASCII	75, 110, 150, 300, 600, 1050, 1200 & 1800 Baud Plus variable non-standard rates from 30 to 251 Baud in 2 baud increments
Packet	300 & 1200 Baud (AX 25)
Baudot	45, 50, 57, 75 & 100 Baud Plus variable non-standard rates from 30 to 251 Baud in 2 baud increments
Sitor	Mode A (ARQ) and Mode B (FEC collective and selective) 100 Baud (with ALTOR automatic feature)
ARQ Moore	2 channel TDM 86, 96 & 100 Baud 4 channel TDM 172, 192 & 200 Baud
ARQ E	ARQ-E 48, 64, 72, 86, 96, 144 and 192 Baud
ARQ E3	ARQ-E3 48, 64, 72, 86, 96, 100 192 and 200 Baud
Morse	5 to 120 wpm auto ranging (in 3 ranges)
Bit Inversion	Baudot based codes only: decodes any combination of bit inversions
Three Shift Cyrillic	Available in Baudot and Baudot-based codes (video display only)
Literal Display Mode	ASCII, Baudot, SITOR and ARQ in all speeds available in these modes (video display)
Databit Display Mode	Synchronous and Asynchronous from 30 to 251 bauds
Filter Tones	High tone (mark = 2125), Low tone (mark = 1275) fixed shifts of 60, 85, 170, 425, 850, and 1200 Hz. are provided, plus a variable function

Figure 1. M-7000 Specifications.

cies vary with days of the week, propagation, and interference. Listings go out of date quickly as stations change schedules, frequencies, and modes to suit the needs of what is usually a very narrow audience. Some of these channels will only have traffic on them for a few minutes a day, and sometimes they will transmit an idle signal for hours at a time.

Even digital radios don't read out the same frequencies when offset into the sideband or RTTY modes, and some listings are reported in USB and some in LSB, so there is always a possibility of signals plus or minus 3 kHz.

Figuring Out the Mode

The real challenge, of course, is figuring out what's being sent by a signal you stumble upon as you tune around the dial. This is a trial and error process which requires practice as you learn to determine by ear which mode is being used. Osterman says he's working on a tutorial cassette tape of the sounds of the various modes, which will save you days of empirical learning.

To some degree, the M-7000's computer helps by having a mode in which it finds the shift and speed of a RTTY signal. It can select automatically between SITOR A and SITOR B. For the more arcane modes, the error and data LEDs signal when a station is tuned in. All of these, however, can be fooled.

The M-7000 also receives FAX transmissions and works almost identically to the Info-Tech M-800 which I previously reviewed for *73 Amateur Radio*. Video FAX is an option which, though providing screen resolutions far inferior to what the M-7000 will produce with a printer, is of great benefit in setting up the equipment and checking out signals without wasting a lot of paper.

You may be surprised to find your two-way ham operations enhanced with the M-7000. It's easy to run receiver audio to both the M-7000 and your RTTY unit, or better yet, to a separate receiver. The nature of RTTY reception is such that one will usually work better than the other, and the M-7000 offers much more opportunity for tinkering with adjustments.

Diversity reception is a unique feature of the M-7000. The unit accepts audio from two different receivers, which should be connected to two different antennas. The M-7000 switches between the two receivers, depending on which is stronger. The theory is that signals will not fade on both antennas at the same time.

Sometimes it helps and sometimes (especially with a high noise environment) it doesn't, but diversity reception is fascinating to watch. You should try it, especially if you want accurate copy over long periods.

Connections and Interactions

The basic hookup of the M-7000 is simple. It needs audio from a receiver and it supplies video to a composite CRT video display. Digital modes are critical, and quality counts. A high quality receiver makes a big difference, and a high quality monitor and double-shielded coax will reduce noise.

The M-7000 can accommodate either a serial or parallel printer, but FAX operation requires an Epson compatible parallel printer. For careful tuning, especially of the more complex modes, an oscilloscope is almost essential. Any conventional audio or RTTY monitor scope can be hooked up to the M-7000.

You can easily control nearly all the M-7000 functions by sending it an ASCII code from your computer. You can transfer data from the M-7000 to your computer in ASCII text as well, of course. You can save data in ASCII text files in your computer's hard disk drive or on floppy disks, and read, edit, or print them out later. Any communication program will suffice for M-7000 control and data transfer, as will any computer, as long as it has an RS-232 compatible port.

Besides the ability to save your data, control with a personal computer allows you to program the M-7000 for your favorite modes. There are 10 memories built into the M-7000 which are accessible through the keypad, but you'll probably want to set up many more with your computer. You can even send the M-7000 a code that transfers the status line settings and time of day to the computer so that you don't have to write down the settings. The status line can always be displayed at the bottom of the video monitor's screen.

You could write a short program to control the M-7000, or you could try one of the many programs available that allow sequences of keyboard characters to be programmed with a single key press.

Problems and Solutions

The only flaw of the M-7000 I've discovered in about a half a year of use is a slight amount of RFI from the computer circuitry in the unit. I've heard much worse from other gear, but I was very surprised that the noises were readily receivable, especially between 10 MHz and 20 MHz.

An antenna with a shielded feedline located some distance from the shack would likely solve the problem. The only trouble with that, however, is that I've always used open-wire feeders as the simplest way to get all-band operation into a city lot. You must use shielded video and printer cables to reduce other RFI problems.

The standard 16-button keypad saves money and provides control flexibility, but you have to constantly check the reference card to remember what does what, unless you have a gifted memory or have been using the M-7000 a long time. Keypads with easily changeable labels would be wonderful. Using a computer to set up the M-7000 with macro commands is a way around this.

Universal provides good service, a newsletter for purchasers, a computer bulletin board exchange of station loggings, and firmware updates as new functions are developed. I must quibble a bit about the price of the updates. While I appreciate them, at $70 a single ROM chip, they do add up.

The M-7000 gives you the chance to have fun listening to what the rest of the world is up to. You feel a real sense of accomplishment when you print out a station for the first time. Also, you'll have something else to talk about the next time you're on the air.

ALTERNATE

LEFT KEYBOARD

BI Manual	Frame Left / Auto Sync	Frame Right / Manual Sync	ARQ-E3
BI Automatic	Bit/Char Up		
Split Screen	Bit/Char Down		ARQ-E
Databit Display	Literal Display	Program	Help

RIGHT KEYBOARD

1	2	3	Mark Freq.
4	5	6	Space Freq.
7	8	9	Shift
	0	Baud	

NORMAL

LEFT KEYBOARD

SRO / Line/Gray	Status Print	Screen Print	CW
Speed Up	Scroll Up	UOS/PAR / IOC	SITOR
Speed Down	Scroll Down	Case Change / Direction	ARQ-M
ASCII	Screen Clear	BAUDOT	PACKET

RIGHT KEYBOARD

NOR/REV / POS/NEG	Filter Tune	Start Stop	Memory Select
Shift Up	VFT Group	ATC	ARQ Channel
Shift Down	Shift	Input Select	Auto Tune
Alphabet	Demod. Mode	AGC	FAX

Figure 2. The M-7000 front panel, and the function charts for its two keyboards.

Calibration and Repair for Bird Wattmeter Elements

Follow these simple, easy steps—and save big money!

by Francis Kelson HL9BK/K2KSY

Some time ago, I received some burned out and well-used Bird and Sierra wattmeter elements.

As I looked over the elements, I wondered if it was possible to gain access to the passive and active elements inside for replacement or restoration. At 55 bucks per, I figured it was worth my time and effort to check it out, since I had well over a thousand dollars worth laying on the bench in front of me. My investigations paid off handsomely.

The front data plates of most elements are simply glued to the face. Take a sharp-edged instrument, insert it beneath the edge of the plate, and peel it back. Some units have the data plates mounted on with rivets—it's quite simple to drill or buff off the heads to remove the plate. Be sure to keep the data plates since you can reuse them. If the plate is destroyed upon removal, you can replace it with an adhesive metallic tape. When cut to the proper diameter, the tape makes an excellent cover and shield.

A Peek Within

Removing the plate exposes the head of a screw that holds the front brass housing to the unit. You'll notice just below this screw a small hole with just the right diameter to permit the entrance of an alignment tool. If the meter's error is linear (that is, always off by the same amount), a simple tweak of the element's variable resistor, located within, brings the meter within specifications. If there is no variable resistor, remove the mounting screw in the center. This should let the brass housing drop out. There you will find a fixed resistor, which you should replace with a Helitrim 7138 mini variable for future calibration.

Diode Fixes

If the meter's element does not work over the specified frequency range, or if it gives no measurement indication at all, its diode may be defective. As with all wattmeters, the diode is usually the culprit in a failed element. It functions to rectify the incoming signal and to provide something of a DC level. The signal is then filtered as usual by a capacitor, which is followed by one or two load resistors.

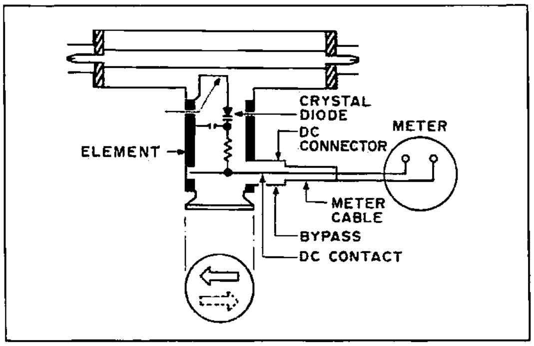


Figure 1. Basic element circuit.

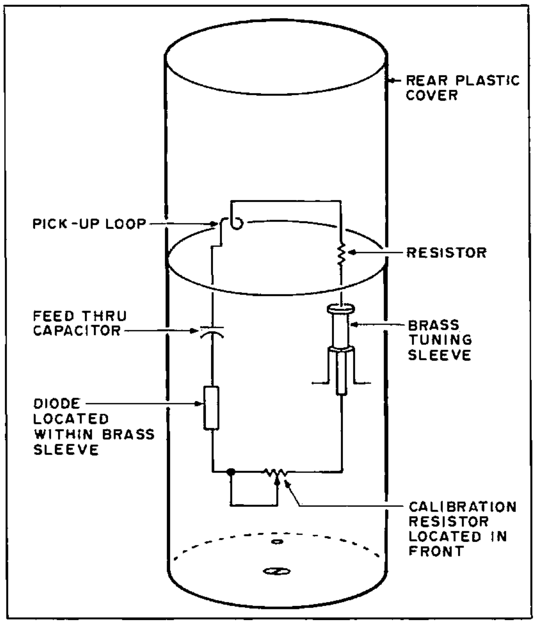


Figure 2. Circuit for the AN/URM-120 element.

To get to the diode, first remove the brass housing in front of the unit, described before. Observe the variable or fixed resistor, and also notice the two recessed screws. Remove them. Then grasp the front housing with one hand and with the other, rotate the plastic cap on the rear. Then exert an outward pressure to force the cap to pop off; this too can be easily replaced.

With the plastic cap removed, notice the two screws in the rear. Desolder the resistor in the front housing. Remove the two screws in the rear and all the components can easily be removed through the rear of the unit.

Check the diode for its proper front-to-back ratio. If it's incorrect, replace it with a suitable diode with the desired frequency response. Remember that diodes and resistors are frequency responsive. If they've been overheated or burned, their main characteristics have changed.

With the rear plastic cap removed, the first item seen is the diode and load resistor. In some cases, as with the 2 through 30 MHz elements, notice the small ferrite block with several turns of #18 enamel wire wrapped around it. This will also be in shunt with a 6Ω resistor. The resistor needs to be desoldered to check the continuity of the coil, which is around 7Ω. This is used to establish the low frequency response along with a feed-through capacitor, which is normally trouble free. Refer to Figure 1 for the concept details.

Something Old, Something New

Some of the older folk should recognize the element shown in Figure 2—the AN/URM-120. It goes all the way back to WWII and is still in use today. Plug those monsters in through the top of the meter housing and rotate the whole slug for forward or reverse.

One of the major wattmeter companies miniaturized the old 120 and created a slug the size of the Bird elements. This one is called the CU2214/U and works considerably better than its older, larger grandfather.

In Figure 2, notice the brass sliding sleeve located on the right side. This is used for frequency response. Within the brass shield, adjust the enclosed diode, the feedthrough capacitor, and the pick-up loop exactly like the CU 753, 754, 755 slugs that went into the AN/URM-120. The CU2214/U slugs are accessed in the same manner as the Bird elements.

Bird and Sierra wattmeters are known and respected throughout the amateur fraternity and engineering fields. The wattmeters are ruggedly constructed and better able to withstand the rigors of military and amateur service—much better than their digital cousins, more so in higher density RF fields. Although the initial money outlay for wattmeter and elements is high, you can now dramatically reduce further expenses on elements with the tech ingenuity hams are famous for!

Number 17 on your Feedback card

AERIAL VIEW

Antenna News

Arliss Thompson W7XU
RR 3, Box 224
Sioux Falls SD 57106

Predicting Reliable VHF/UHF Coverage

Those of you familiar with the bands above 50 MHz know that, under the proper conditions, some interesting long distance communications are possible at those frequencies. An F2 opening to Europe on 6 meters or a long distance tropo opening on 1296 MHz should excite even the non-VHFer, but unfortunately such openings are not as frequent as we would like. A typical comment on this subject from a ham whose primary interest is HF communications might be something like this: "Sure, the band openings are fun, but I want to work stations more than once a month. Who wants to sit around and listen to receiver hiss all day? Except for rare occasions, you can't work anyone much beyond line-of-sight at those frequencies. Give me 80 meters and you can have everything higher than 30 MHz."

In an effort to counter some of the misconceptions expressed by hams such as the one above, D. W. Bray K2LMG, published an article in the November 1961 issue of *QST* entitled "A Method for Determining VHF Station Capabilities." Bray's work, which later appeared in *The Radio Amateur's VHF Handbook* and in the latest edition of *The ARRL Antenna Handbook*, showed hams how to estimate the capabilities of their stations and how to determine what sort of coverage they could expect on a day-to-day basis at VHF and above. To do this, the reader had to determine station gain through the use of a number of nomograms, then refer to another nomogram to estimate path loss. If station gain exceeded the path loss, then it should be possible to communicate over the given distance on a daily basis (99 percent reliability, assuming smooth earth between the stations). In brief, his work was a graphical demonstration of the fact that relatively minor changes in station capabilities can yield big improvements in reliable coverage, and that in fact VHF/UHF frequencies are good for much better than line-of-sight communications on a day-to-day basis between well-equipped stations. However, although the concept was interesting, it was rather tedious going through the calculations and working your way through the graphs, especially if you wanted to test a number of possible station configurations.

This month's column is devoted to an effort to model K2LMG's work on a computer. Use of the computer greatly simplifies the analysis and allows proposed changes in the station setup to be evaluated in moments with minimal effort.

How the Program Works

With this program, the user enters the distance between the transmitting and receiving stations, plus some information about the two stations, then the computer calculates the minimum transmitting antenna gain needed for reliable communications under those circumstances. The need to specify the distance between the stations is obvious: greater transmission distances incur greater losses. It is also necessary to specify the frequency band of operation because losses over a given path increase with frequency. The program asks the user to enter the mode of operation since some modes of operation inherently require greater signal-to-noise ratios than others for effective communication (CW does have its advantages).

Lines 30 through 340 of the program also require the user to enter 7 of the 8 parameters that determine station gain. Those factors are: transmitter power output, transmission feedline loss, transmitting antenna height, receiver sensitivity, receiving feedline loss, receiving antenna gain, and receiving antenna height. The transmission and receiving feedline losses are negative factors that detract from overall station gain while the other items serve to increase it. Later in the program the computer takes this information and converts it into decibels of gain or loss and balances that against the path loss in dB.

Entering the above parameters is pretty straightforward, except possibly for the receiver sensitivity. Transmitter output in Watts should be readily available, and you probably have a good estimate of feedline losses (if not, that information is available in the various handbooks). The program requires that the receiver sensitivity be entered in dBm (decibels below a milliwatt), a figure that may or may not appear in your rig's manual. If the receiver sensitivity is known for a given signal-to-noise ratio, you can calculate receiver sensitivity using the formula:

Receiver sensitivity (dBm) = $\{10 \times \log(E \times E)\} - 107 - S/N$ where E is the receiver sensitivity in microvolts for a given signal-to-noise ratio, S/N, assuming 50Ω Impedance. For instance, if your receiver has a sensitivity of 0.1 microvolts for a 10 dB signal-to-noise ratio, the sensitivity in dBm will be −137. If the only information you have available is your equipment's noise figure you can refer to Bray's nomogram to determine effective receiver sensitivity. (Note that the nomogram gives receiver sensitivity in dBw, not dBm. Since the program uses dBm, use of the nomogram will require the conversion dBm = dBw − 30. Also, that nomogram includes receiving line loss, so if it used to determine receiver sensitivity you will need to enter "0" when the program asks for receiving feedline loss).

Once the above data Is entered into the program, the computer does the work. In lines 400–520, the antenna height gain is calculated. At lines 600–610 and at 820,

```
10 CLS
20 PRINT "A program for estimating transmitting antenna gain for
         VHF/UHF operation.":PRINT:PRINT
300PRINT "Enter frequancy band (use upper case letters A,B,C,D,E,F)
400PRINT "                           A - 50 MHz
50 PRINT "                           B - 144
60 PRINT "                           C - 222
70 PRINT "                           D - 432
80 PRINT "                           E - 902
90 PRINT "                           F - 1296
100 INPUT F$
110 PRINT "Enter mode of operation (A,B,C)
120 PRINT "                           A - CW"
130 PRINT "                           B - SSB"
150 PRINT "                           C - AM"
160 INPUT M$
170 PRINT "Enter distance in miles (>10) between transmitting and
          receiving stations."
180 INPUT D
190 PRINT "Enter transmitting station data:"
200 PRINT "        Power output (watts)"
210 INPUT TP
220 PRINT "        Feedline loss (dB)"
230 INPUT TFL
240 PRINT "        Antenna height (feet)"
250 INPUT TAH:PRINT:PRINT
260 PRINT "Enter receiving station data:"
270 PRINT "        Receiver sensitivity (a negative number
               expressing sensitivity"
275 PRINT "        in dB below 1 milliwatt (dBm))"
280 INPUT RS:RS=-RS
285 RS=RS+30
290 PRINT "        Feedline loss (dB)"
300 INPUT RFL
310 PRINT "        Antenna gain (dBd)"
320 INPUT RAC
330 PRINT "        Antenna height (feet)"
340 INPUT RAH
400 'Calculate antenna height gain'
410 IF TAH<=30 THEN THG=20|asteris|LOG(TAH/30)/2.302585
420 IF TAH<=30 THEN GOTO 470
430 IF 20<D THEN THG=14.95|asteris|LOG(TAH/30)/2.302585
440 IF 55<D THEN THG=13.29|asteris|LOG(TAH/30)/2.302585
450 IF 65<D THEN THG=11.63|asteris|LOG(TAH/30)/2.302585
468 IF 80<D THEN THG=9.97|asteris|LOG(TAH/30)/2.302585
478 IF RAH<=30 THEN RHG=20|astaris|LOG(RAH/30)/2.302585
480 IF RAH<=30 THEN GOTO 600
490 IF 20<D THEN RHG=14.95|asteris|LOG(RAH/30)/2.302585
500 IF 55<D THEN RHG=13.29|asteris|LOG(RAH/30)/2.302585
510 IF 65<D THEN RHG=11.63|asteris|LOG(RAH/30)/2.302585
520 IF 80<D THEN RHG=9.97|asteris|LOG(RAH/30)/2.302585
600 'Add 4 dB ground reflection gain, receiving antenna'
610 RAG=RAG+4
700 'Calculate effective receiver sensitivity (ERS)'
710 ERS=RS-RFL+RAG+RHG
800 'Calculate effective transmitting gain (ETG), including 4 dB
     transmitting antenna ground reflection gain'
810 TPDB=10|asteris|LOG(TP)/2.302585
820 ETG=TPDB-TFL+THG+4
900 'Calculate path loss (PL) at 50/144 MHz'
910 PL=1.078|asteris|D+127.59
920 IF D>38.5 THEN PL=.523|asteris|D+148.97
930 IF D>72.6 THEN PL=.295|asteris|D+165.52
940 IF D>104 THEN PL=.077|asteris|D+188.28
950 IF D>125 THEN PL=197.93
960 IF D>223.5 THEN PL=.179|asteris|D+157.93
970 IF D>411 THEN PL=.127|asteris|D+179.31
1000 'Adjust PL for increasing frequency'
1010 IF F$="C" THEN PL=PL+3.76
1020 IF F$="D" THEN PL=PL+9.54
1030 IF F$="E" THEN PL=PL+15.94
1040 IF F$="F" THEN PL=PL+19.08 ELSE PL=PL
1100 'Allowance for loss due to fading'
1110 IF D<100 THEN PL=PL+(D/100)|asteris|7 ELSE PL=PL+7
1200 'Allowance for signal-to-noise ratios required for different modes'
1210 IF M$="B" THEN PL=PL+3
1220 IF M$="C" THEN PL=PL+7 ELSE PL=PL
1300 'Calculate needed transmitting antenna gain'
1310 TAG=PL-ERS-ETG
1400 'Print results'
1410 CLS
1420 IF F$="A" THEN FR$="50"
1430 IF F$="B" THEN FR$="144"
1440 IF F$="C" THEN FR$="222"
1450 IF F$="D" THEN FR$="432"
1460 IF F$="E" THEN FR$="902"
1470 IF F$="F" THEN FR$="1296"
1480 IF M$="A" THEN MM$="CW"
1490 IF M$="B" THEN MM$="SSB"
1500 IF M$="C" THEN MM$="AM"
1510 PRINT "(A) ":FR$:"MHz","(B) Mode:":MM$
1520 PRINT "(C) Distance between stations",D,"miles"
1530 PRINT "(D) Transmitter output power",TP,"watts"
1540 PRINT "(E) Transmission feedline loss",TFL,"dB"
1550 PRINT "(F) Transmitting antenna height",TAH,"feet"
1560 PRINT "(G) Receiver sensitivity    ",-RS+30,"dBm"
1570 PRINT "(H) Receiving feedline loss ",RFL,"dB"
1580 PRINT "(I) Receiving antenna gain  ",RAG-4,"dB"
1590 PRINT "(J) Receiving antenna height",RAH,"feet"
1600 PRINT:PRINT
1610 PRINT "Calculated minimum transmitting antenna gain (dBd) needed"
1620 PRINT "   to overcome path lose (assuming need to maintain high"
1630 PRINT "   reliability) is:":PRINT:PRINT
1640 PRINT TAG,"db":PRINT:PRINT
1650 PRINT "Enter 'X' to exit or 'A,B,C,D,E,F,G,H,I,J' to change
           any of the values above.
1660 INPUT R$
1670 IF R$="X" THEN END ELSE PRINT "enter new value"
1680 IF R$="A" THEN PRINT "(A)50 (B)144 (C)222 (D)432 (E) 902
                          (F)1296":INPUT F$:GOTO 900
1690 IF R$="B" THEN PRINT "(A)CW (B)SSB (C)AM":INPUT M$:GOTO 900
1700 IF R$="C" THEN INPUT D:TAG=TAG-4:RAG=RAG-4:GOTO 400
1710 IF R$="D" THEN INPUT TP:GOTO 800
1720 IF R$="E" THEN INPUT TFL:GOTO 800
1730 IF R$="F" THEN INPUT TAH:TAG=TAG-4:RAG=RAG-4:GOTO 400
1740 IF R$="G" THEN INPUT RS:RS=-RS+30:GOTO 700
1750 IF R$="H" THEN INPUT RFL:GOTO 700
1760 IF R$="I" THEN INPUT RAG:GOTO 600
1770 IF R$="J" THEN INPUT RAH:TAG=TAG-4:RAG=RAG-4:GOTO 470
```

Program that determines reliable VHF/UHF coverage. It uses seven user-entered parameters that determine station gain. This programs was written in GW-BASIC, but should be easily modifiable to run in other forms of BASIC.

4 dB of additional gain is added in, due to ground reflection gain for the transmitting and receiving antennas. The effective receiver sensitivity is calculated in lines 700–710 and, as noted in the program, the effective transmitting gain is determined in lines 800–820.

Program lines 900–970 calculate the path loss at VHF for the distance between the transmitting and receiving stations. Note that the relationship between path loss over real earth and distance is not a linear one. Bray's article contains some graphs that demonstrate this clearly, and show why relatively minor changes in your station may lead to a notable increase in effective range.

The path loss calculated above is adjusted for increased losses at higher frequencies in lines 1000–1040. Further on, allowances are made for fading (plus or −17 dB from the average level at 100 miles) and required signal-to-noise ratios for modes other than CW.

Finally, in lines 1300–1310, the needed transmitting antenna gain is calculated. If a negative number appears here in the printout, it simply means that station gain could be reduced to the degree indicated while still maintaining contact. Lines 1400–1640 print to the screen the initial conditions specified and the calculated transmitting antenna gain needed for those conditions. Subsequent portions of the program allow a change to be made in any of the initially specified parameters and a new gain figure is then calculated. An example:

Frequency: 144 MHz
Mode: SSB
Distance: 100 miles
Power out: 10 W
Transmitter feedline loss: 2 dB
Transmitting antenna height: 30 feet
Receiver sensitivity: −142 dBm
Receiving feedline loss: 2 dB
Receiving antenna gain: 10 dB
Receiving antenna height: 50 feet
Needed transmitting antenna gain: approximately 6.8 dB

Other Thoughts

This program was written on a Tandy 1000SX in GW-BASIC. If you have an IBM-compatible computer, you should be able to enter the program as is and have it work. If your computer uses a different version on BASIC, you may need to make some modifications in the listing. In the past, I have received requests to rewrite a program so that it would run on a Commodore or some other manufacturer's computer. Unfortunately, I do not have access to those machines and cannot supply such listings. I may be able to point out one potential source of difficulty in translating the program, however, and that deals with the calculation of logarithms. Although the program listing has lines containing statements such as "LOG (X)," the computer actually calculates the natural (base e) log, not the base 10 log that is implied. That is why the correction factor of 2.302585 appears in lines using the LOG function. If your computer calculates base 10 logarithms with the LOG command you will need to remove the above noted correction factor to get proper results. It's an easily made correction, but it's an example of what changes may be necessary when translating between different versions of BASIC. (If your computer executes the command "PRINT LOG(100)" and comes back with "2", you know it is already doing base 10 logs).

I am interested in reader-suggested improvements to this program. One likely area for improvement concerns the modeling of the path loss curves that appeared in the original article. While this version of the program gives reasonable linear approximations of the path loss curves, they are just that, approximations. Perhaps some reader has better data and skills in this regard.

Other Business

Fred Sontag N0CAO/KA2XAE sent along some interesting information regarding the February 1989 "Aerial View" column on simple 17m antennas. It seems that Fred has an experimental license to operate on 17 meters and states that he and other members of his experimental group are getting good results with easily built antennas, including dipoles, vee-beams, a modified Butternut ground-mounted vertical, and a G5RV antenna. The experimental group (Bill Orr W6SAI/KM2XDW, California; Stu Cowan W2LX/KM2XDU, New Hampshire; Bob Stankus WS4I/KB2XCQ, Virginia; Phil Galasso K2PG/KA2XUK, New Jersey; and Fred N0CAO/KA2XAE, Missouri) hold schedules regularly on Saturdays and Sundays at 1600 and 1900 UTC on 18.111 MHz. While you won't be able to join them on the air until this summer (when the band is scheduled for release to US hams), they welcome signal reports from listeners. ■

Continued from page 26

wooden dowel for rigidity, drill the vertical and horizontal spreader holes with an offset up to ½". Then you can use one solid metal spreader support for adding stability. The ½" offset will not make any significant changes in the antenna's performance.

How to Build a Basic Quad

1. If you want only the 2 meter antenna, omit all 220 references.
2. Study all diagrams and illustrations before continuing. Cut and drill all the hardware.

NOTE: If you're building a dual-band version, be sure to connect the appropriate radios to the coax ends during tune up.

3. Before tuning, install all aluminum spreader supports, the metal mast, and hardware that you are going to use. (This allows you to compensate for any reflection.) Make the Bazooka Balun, and firmly tape down the coax and balun to the spreader, boom, and mast.
4. Tune up the antenna with as little surrounding metal as possible, and with the quad pointing away from any near structures. Construct the reflector and driver of both bands by dimensions. Do not solder; *tape* the coax baluns into place.
5. Tune-up procedure. For dual-band only: tune up the 220 band antenna first, then the 2 meter band. Because of interaction between the band elements, you will have to refine your tuning on both drivers.

For tune-up, use 146.000 MHz and 223.000 MHz. Adjust the driver feedpoints. By increasing or decreasing reflector wire length, you can obtain the lowest SWR reading at the selected frequency. HINT: Adjust the drive's best SWR and trim up with reflector, then go back to the driver and retrim, etc. You can usually expect the following results:

Reflector and Driver Only SWR

144.100..........1.7:1223.500..........1:1
145.000..........1.4:1223.000..........1:1
145.500............1:1222.500..........1:1
148.000............1:1222.000..........1.3:1

6. Permanently install and solder the directors to the specified dimensions. SWR will probably go up, which will require going back to step four and tuning/trimming up again to obtain the best SWR.

Typical Results

144.100..........2.3:1224.000..........1.2:1
145.000..........1.4:1223.500..........1:1
145.500............1:1223.000..........1:1
147.500............1:1222.500..........1:1
148.000..........1.2:1222.000..........1.4:1

7. When SWR is as low as you can get it, solder and fasten down the reflector. Recheck the SWR and trim with the driver. Then solder the driver but *don't fasten it down.*
8. Measure all spreader elements to insure a proper diamond shape. Straighten and align spreaders so they line up.
9. If you have a field strength meter or a distant visual repeater, adjust the front lobe for directivity. First, move the horizontal driver spreaders left or right to obtain maximum indication on the field strength or S-meter reading. When sighting down the vertical spreaders, the antenna of the meter or repeater is hidden by the spreaders. This alignment is critical for the accuracy of the beam bearing.
10. You now have a finished antenna! Preserve the antenna in any fashion you deem necessary for your environment. I recommend caulking the coax on the driver feed connections with silicon, brushing marine spar varnish over a coat of paint, and pegging the spreader wooden dowels.

See you on the hunt!

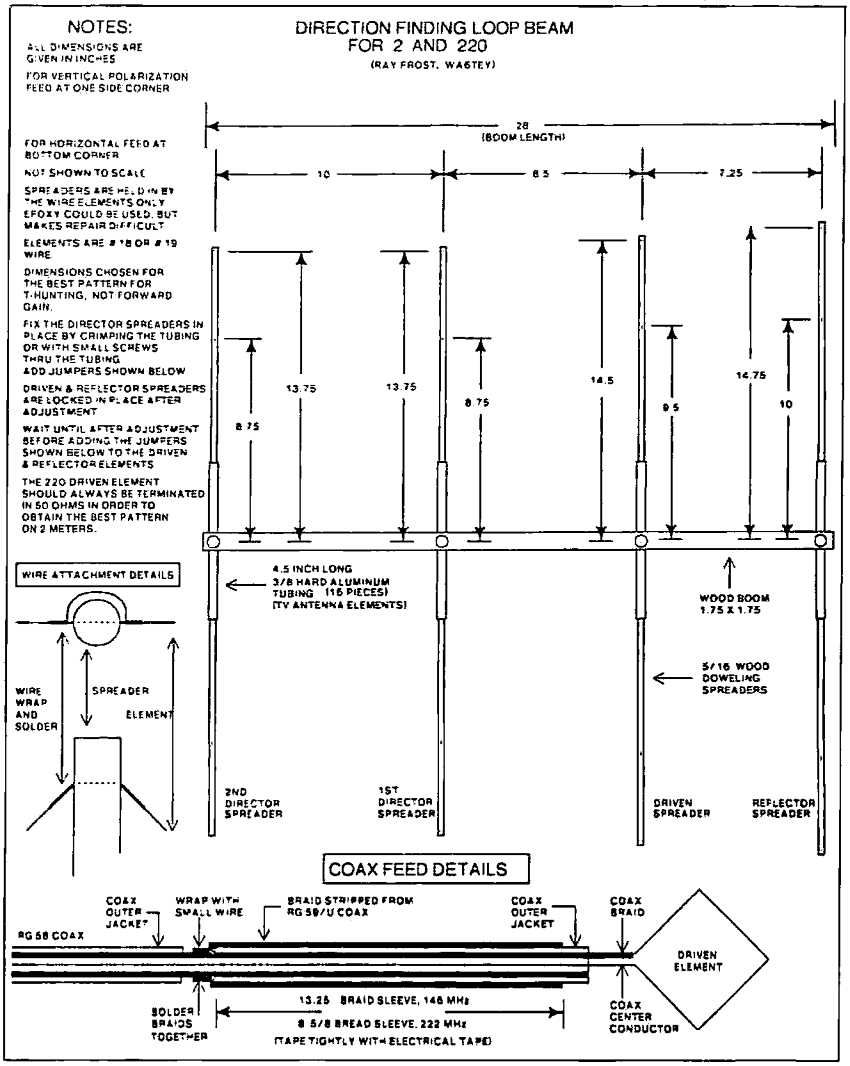


Figure 1. Direction Finding Loop Beam for 2m and 220.

BASE DIMENSIONS FOR QUADS

Elements	Y	Z*4	Element Spacing	Bazooka
2 meters, 146.000 MHz				
reflector	14.75	86.4	7.25	13.25
driver	14.5	82.0	8.5	
directors	13.75	77.6	10	
1-¼ meters, 223.000 MHz				
reflector	10	57.0	7.25	8.66
driver	9.5	53.5	8.5	
directors	8.75	50.0	10	

*All dimensions are in tenths of inches.

Number 19 on your Feedback card

Stay With the State Of The Art

Cheap way to stay on the cutting edge.

by Peter Doherty W1UO

Electronics is a fast-moving industry. Did you ever wonder about how you might keep up with all the new products flooding the market every month, before they become old news? If you are an advanced hobbyist, then you are probably itching to experiment with the newest products as soon as they hit the market.

Finding out about what's new in electronics may be easier than you think. Armed with no more than a roll of stamps, you can be on top of the latest in the electronics industry.

I can hear you moaning already. With the postage to pay and the kids' college expenses coming up, you can barely afford subscriptions to the ham magazines. Well, if you qualify, you can receive dozens of electronic trade magazines at no cost. These trade magazines cover new products, often before they become readily available to the general public. Manufacturers advertise their new products in hopes that others will implement them into their latest designs. These magazines also contain information on how to use all these new products.

Sources and Resources

One of the best sources of information on components and equipment is *Electronic Component News*, published by Chilton. This glossy, color tabloid lists hundreds of new items each month, dealing with items as small as capacitors and as large as computers. Also included in each issue is a focus article on products at the technological horizon. For instance, the latest issue has an in-depth discussion of CMOS Array Logic. These focus articles contain a wealth of information on the background theory and use of the featured products.

Another useful magazine is *Electronic Products*, published by Hearst Business Communications. It, too, has a wealth of advertising, besides many feature articles. For instance, the latest issue has four articles on power supplies, as well as articles on static RAMs and electroluminescent displays. The "Products Highlights" section contains brief discussions on the latest in product technology, with good descriptions and prices, while the IC Update section contains the latest lists of new integrated circuits rolling out of the foundries.

Electronic Manufacturing, published by Lake Publishing, focuses more on the actual assembly of electronics instead of the individual components used. Recent articles looked at cabinets, enclosures, and EMI/RFI shielding. This magazine also contains a "New Products" section. If you need to know how to build and where to enclose your latest electronic creation, this is the place to look.

When it gets down to the actual design, a good source of information is *Electronic Design*, by Hayden Publishing. With sections devoted to design perspectives, innovations, reports, and applications, it looks at the process of turning ideas into hardware. The applications section is especially handy in this regard. A current article deals with the 80386 CPU chip and its role in desktop CAE tools.

If you're interested in computers, *Computer Design*, by PennWell Publishing, would be to your liking. It deals with computer technology from the chip level to the system level. Recent articles featured Gallium Arsenide ICs and disk drive technology. Again, the advertisements abound with useful information.

As the name implies, *Microwaves & RF* covers the radio spectrum, from low frequency RF to the upper limits. It has news of the latest projects, designs, and product technology. Its design feature section recently contained an excellent article on using spectrum analyzers in IMD measurements. With the increasing interest in the microwave frequencies, and the age-old interest in RF, this magazine presents some of the best information around.

For news, try *Electronic Engineering Times*, by CMP Publications. In newspaper format, it comments on people and companies. It has the friendly feel of a cup of coffee and your morning newspaper. There is always a lively debate in the "Letters" section, and the editorials are stimulating. Given its audience, it is heavy with product advertisements.

No discussion would be complete without mentioning the source of ideas from out of this world—*NASA Tech Briefs*, by Associated Business Publications. It contains great information on the research of ingenious individuals. Many of the products and ideas are not even on the market yet; they're waiting for some entrepreneur to turn them into reality. Not only does this magazine have sections on electronic components, circuits, and systems, but it also covers physical science, materials, computer programs, mechanics, machinery, fabrication, mathematics, and life sciences. A recent issue featured NASA technology applied to solar powered vehicles. For technology and ideas pushing the outer limits, this magazine makes for fascinating reading.

Getting Connected

It's not hard to tap into this wealth of information. If you are a qualified person, all the above publications are FREE. What qualifies you? You or your company must be involved in the field that the magazine focuses on. First, write to the magazine you're interested in, preferably on company letterhead, and ask for a subscription form. If your line of work is not in electronics, but if you're a dedicated experimenter, then it's up to you to convince the publisher of your qualifications. If you don't qualify for a free subscription, you'll be asked to pay for it. When you receive your subscription card, just fill it out and send it back. About every six to twelve months, you'll be asked to renew your subscription by filling out a new card.

The following list is not exhaustive, but it's a good place to start. Be forewarned, as your name will be put on free subscription mailing lists and magazine offers will flood in. With all the new products and ideas to experiment with, the hardest thing will be finding the time to read all this good information!

Electronic Trade Magazines

Electronic Component News
Chilton Company
Chilton Way
PO Box 2010
Radnor PA 19089

Electronic Products
Hearst Business Communications, Inc.
645 Stewart Ave.
Garden City NY 11530

Electronic Manufacturing
Lake Publishing Corp.
PO Box 159
17730 W. Peterson Road
Libertyville IL 60048

Electronic Design/Microwaves & RF
Hayden Publishing Co., Inc.
10 Mulholland Drive
Hasbrouck Heights NJ 07604

Electronic Servicing and Technology
PO Box 12901
Overland Park, KS 66212-9981

Computer Design
PennWell Publishing Company
PO Box 417
119 Russell St.
Littleton MA 01460

Electronic Engineers Times
CMP Publications, Inc.
PO Box 2010
Manhasset NY 11030

NASA Tech Briefs
NASA STI Facility
Manager, TU Division
PO Box 8757
Baltimore MD 21240

EDN
275 Washington St.
Newton, MA 02158

RF Design
6300 S. Syracuse Way
Suite 650
Englewood, CO 80111

Number 20 on your Feedback card

ABOVE AND BEYOND

VHF and UHF Operation

Chuck Houghton WB6IGP
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10 GHz Contest Preparations

For the upcoming 10 GHz ARRL microwave contest, I would like to cover a few items related to system improvements that can increase your contacts and provide ease of operation. Most of the first items are related to the tripod and antenna system, and how to properly aim a dish antenna at a remote station. In another column, we will cover the use of a grid square direction and distance location program that you can run on your computer, using BASIC.

Also, with news of involvement of amateurs in your local area who are putting on nets for VHF/UHF and microwave activity, we will create a common ground and larger sharing of ideas and construction notes. This assistance can be put to great advantage. We'll cover the antenna and what can be done to improve on the base, and work our way to the feed or system transceiver.

Tripod for a Dish Antenna

A tripod that will support a microwave dish antenna should be sturdy, yet still small enough to be carried or packed in a car trunk for transportation. Camera or general purpose photographic tripods are good for a start, but they are not sturdy enough to hold a small dish antenna. In a pinch, heavily weighted, you can make them work. One possible source of surplus tripods in your area is your local television station, college, or vocational school. Also, check your local land surveyors, as any of them might just have a surplus tripod available for relatively little outlay. Kerry Banke N6IZW, one of our local group members, picked up an excellent wooden tripod at a local surveyor's shop for next to nothing. It has adjustable legs, and folds up to a very small unit about 2½ feet long. Check out your local shops to see what you can find. You just might get lucky.

Once you have acquired your tripod, fix a compass setting circle on top of the mount. The compass dial or setting circle should be from eight to 16 inches in diameter. My tripod uses a setting circle 16 inches wide from the front plate of a radar O-scope. Some people have taken two protractors and placed them back to back to form the setting circle. Whatever you use, mount it in the clear to be able to set your antenna pointing to any compass heading you desire.

Once you have secured your setting circle to the bottom part of the mount, attach a pointer to a part of the mount that will rotate and not be in the way when the mount is turned full circle. Select a spot that will not get in the way when you unlock the mount to lock in a microwave signal. All you need is a short piece of metal or plastic to serve as a pointing indicator. This will be your compass setting pointer, and the dish and pointer are set up to magnetic north first before using.

The rest of this month's column is devoted to Jack N6XQ, and his novel 10 GHz antenna system. Take it away, Jack!

". . . keep the dish accuracy to within 1/16 of a wavelength (0.07")."

Home-brew Odyssey—10 GHz Antenna System

I came up with a different approach when I couldn't locate a dish antenna or suitable tripod—I built one out of wood! The equipment is relatively simple, and the finished product works very well. The ball got rolling when several Solfan microwave burglar alarm units came my way for free, motivating me to get them in use on the 10 GHz ham band (10000–10500 MHz). A brief literature search found that others did this with minimal hardware and effort. I was soon on the air talking to myself through a second Solfan at home on the workbench. A first QSO attempt with W6OYJ on Mt. Soledad eight miles away failed. A trip to WB6IGP's test bench soon showed why sirens went off in the neighborhood during transmission—several turns with a screwdriver put it right back on frequency. A few days later, I had my first X-band contact with W6OYJ!

Now I was hooked on the excitement of working other hams full duplex with just a few milliwatts. This excitement wore off, however, when it became apparent that the reliable line-of-sight range was about 25 miles with the small Solfan horn. A dish was the obvious answer, but a search through the local surplus markets turned up nothing. Contest time rapidly approached, so I decided to shift my efforts into building a dish.

The RSGB *VHF/UHF Manual* has the most comprehensive discussions on dish design parameters. The first decision to make: how large should the dish be? I had to keep it as small as possible,

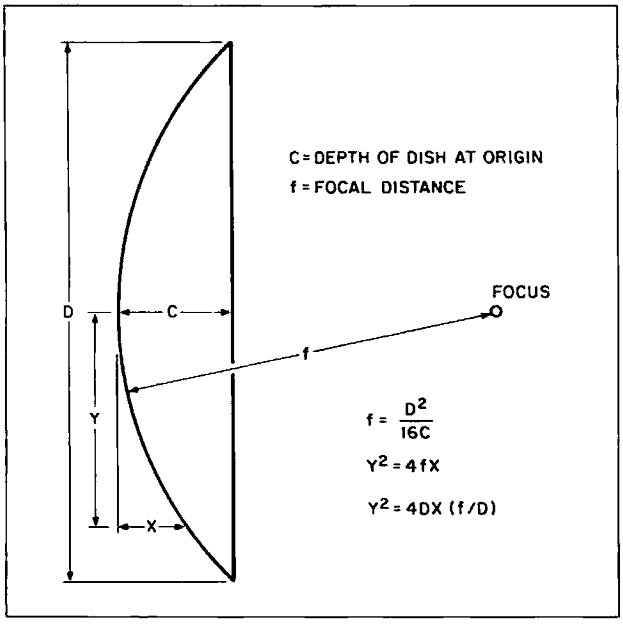

Figure 1. Plan for the paraboloid, showing the relevant dimensions.

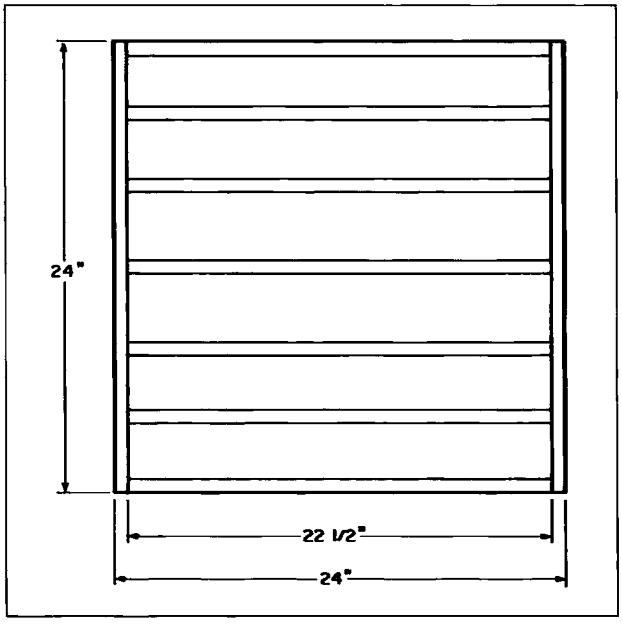

Figure 2. Dish frame layout.

Photo A. Tripod construction with base stabilizer about one foot from the bottom end. Three hinges hold the three legs onto the wood base.

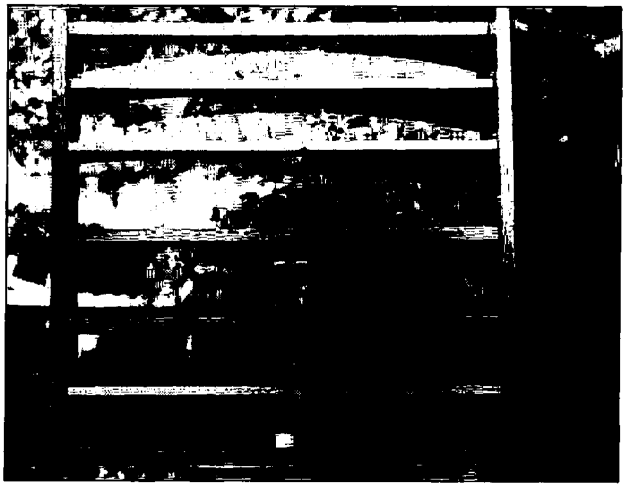

Photo B. N6QO's 10 GHz antenna. Rear view of the dish antenna showing microwave horn antenna feeding the center of the dish. Note the compass degree markings on the base of the unit. The PVC pipe in the center of the mount serves as a bushing.

since most 10 GHz contacts are made from high, unobstructed locations, requiring portable equipment. I decided on a two-foot dish which theoretically has a gain of 35 dBi and a beamwidth of three degrees.

One very important advantage in home-brewing a dish is that you can optimize the dish for your feed antenna. Most hams get all excited about finding a nice dish on the surplus market, only to be confronted with the task of building an optimum feed. Through comparative tests, I estimated the Solfan horn antenna to have a gain of 10–11 dBi. After I constructed the antenna, I discovered the gain is actually around 12 or 13 dBi. This problem was easily cured (discussed later). According to my original estimate, the dish is optimally illuminated with a F/D of 0.8. (See next paragraph for explanation.) This is convenient, as it results in a fairly flat dish which is easy to build. The 24-inch dish will have a focal point of 19.2 inches.

Techies, FYI

See Figure 1, the diagram for the paraboloid. "C" is the depth of the dish. This is the line from the center of the dish to the plane described by the dish rim. "D" is the dish diameter. "F" is the focal distance, which is where the incoming wave energy reflecting off the dish maximally converges. This is the obvious place to mount the feedhorn. The three useful formulas here are: $F = D^2/16C$, $Y^2 = 4FX$, and $Y^2 = 4DX(F/D)$. X and Y are coordinate pairs along the dish curve. Table 1 offers the X/Y pairs for building the dish shown in Figure 2.

Fabricating the Dish

Fashioning a precision parabolic surface is likely the most difficult task for the average amateur. Fiberglass is probably a good material, but it was discounted because it involves making an initial mold, and requires some working experience.

I had seen articles on wooden dishes with ribs that extend out radially from the center. They usually use round loops of varying diameters for additional strength, and to support the mesh material. What about building a square dish that had support members running in only two orthogonal directions? To my surprise, I discovered that the basic parabolic curve of any structural rib was the same regardless of where it was placed or in which direction it ran. Thus, it was easy to design a square dish and easy to make it with right angle joints. It has an advantage for portable operation, too—the flat bottom is convenient for supporting and rotating the dish at its center of gravity. Figure 2 shows the basic layout of the dish frame.

I recommend using good quality wood to insure lasting accuracy. For the sides and bottom I used some left over 1 x 6-inch door jamb stock that was surfaced on four sides and kiln dried. Equivalent material in the lumber yard costs about 90 cents per foot. You can use 1 x 3s, which cost about 30 cents a foot, for the interior lateral boards. Three-quarter-inch stock is overkill, and the extra milling required to produce half-inch stock is not worth it unless you are considering weight.

Antenna Screen

The mesh used is aluminum insect screening, readily available and inexpensive. The loss with this mesh is negligible, even at K-band. The screening conforms well to the parabolic shape of the relatively flat dish. I applied a coat of enamel over the zinc chromate primer to extend the life of the mesh—important when you live near the ocean!

The theoretical gain of a dish is achieved only when the shape is perfectly paraboloid and optimally fed. A wavelength at 10 GHz is about 1.15 inches. My design goal was to keep the dish accuracy to within 1/16 of a wavelength (0.07 inch). This inaccuracy sacrifices about 1 dB of gain. Gain diminishes rapidly with greater inaccuracy—a 1.9 wavelength (0.128 inch) error results in 6 dB loss! An antenna with this error factor has no more gain than a perfect paraboloid antenna one-half its diame-

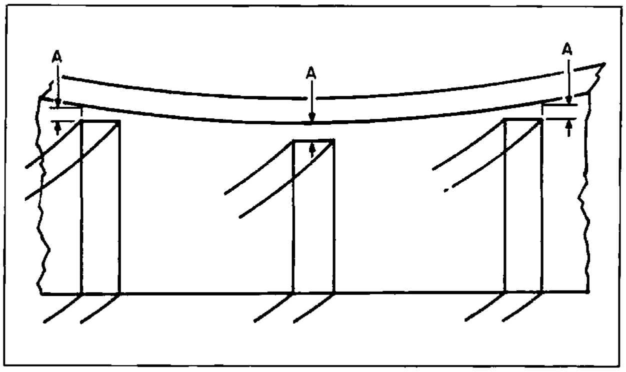

Figure 4. Placement of lateral boards to side boards. For side boards with a thickness of ¾", A = .23".

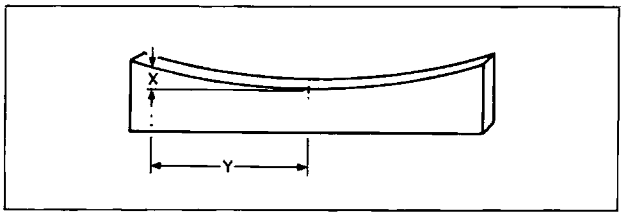

Figure 3. Method for fashioning the template.

Photo C. Front view of N6XQ's completed dish antenna and Solfan feed system, tripod mounted and ready to use. This system works very well and costs little to build.

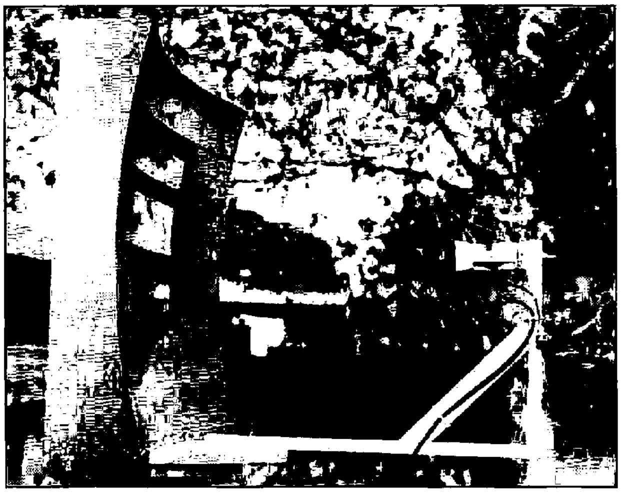

Photo D. Side diagonal view showing the supporting members holding the wire mesh.

"The RSGB* VHF/UHF Manual *has the most comprehensive discussions on dish design parameters."

ter. Measure and fabricate as accurately as possible. Take care to not rush during cutting and assembly.

Performance

This antenna has really held its own in the field. I have made contacts of 175 and 208 miles with the 10 milliwatt Solfan transceiver system, shown in the photographs. The 208 mile contact was over a water path with station elevations of 400 and 200 feet, respectively. The horn feed antenna was recently trimmed by ¼ inch to reduce the gain so that it would match the wooden dish better. Dish gain went up ¾ dB.

The bottom of the dish frame and the feed horn support have a single piece of wood stock to allow attachment to the top of the tripod base. After marking the lower wood tripod base with a compass dial, this dish has everything to enable you to point your microwave dish antenna properly.

Each time you place the tripod in operation, properly position the mount with compass setting circle. Take a compass bearing on magnetic north and set up the front of the dish and the compass pointer to agree, with both pointing toward magnetic north. When you want to aim your dish in another direction, just unlock the upper part of the mount, keeping the compass setting circle In place on the lower part of the mount. Then rotate the dish to the new magnetic bearing. By keeping the base of the tripod always pointing direct magnetic north, you don't have to guess about the location of the other station.

Y	X
0	0
1	.013
2	.052
3	.117
4	.208
5	.325
6	.468
7	.638
8	.833
9	1.054
10	1.302
11	1.576
12	1.875
13	2.20
14	2.55
15	2.93
16	3.33
17	3.76

Table 1. X/Y coordinate values for the dish curve, corresponding to an F/D of 0.8. The last five Y values, 13–17, are used only for template to check final alignment.

The Other Station's Magnetic Bearing

Two methods are used to obtain the other station's magnetic bearing from your transmitting location. In the first method, you obtain a large, detailed map of the area. For short-range, line-of-sight contacts, a standard city map works fine, but longer distances may require a US Geodetic Survey map. This pen-and-ink method works well, but it takes time and care to determine location and compass bearings.

In the second method, you run a grid square program on your computer which uses the six-figure grid square identification, which you need for exchanging on 10 GHz contacts. (See grid square ID program article in last month's issue.) This program, assembled by Leon WA5BNH, will give you forward and reverse compass bearings as well as distance measurements in miles and kilometers between selected locations. This is the program we use in our San Diego Microwave Group. ■

Constructing the 10 GHz Tripod

1. Make the template. Select a straight board 34 inches long, and draw the curve, as shown in Figure 3, according to the figures in Table 1. Carefully cut the curve with a jigsaw. Save the concave piece as a template, and for checking the accuracy of the assembled dish. The convex piece can be cut to 24 inches and used as one of the two side boards.
2. Using the template, cut an additional 24-inch side board and seven 22½-inch lateral boards.
3. Assemble the two side boards to two lateral boards to form a square. Make the assembly on a perfectly flat surface to preserve dish accuracy. I used a combination of finishing nails, wood screws, and glue to make the frame strong.
4. Assemble the remaining lateral boards in accordance with Figures 2 and 4. Placement of the lateral boards is not critical except for complying with dimensions "A" in Figure 4.
5. File or sand the flat edges of the cut boards to conform to the parabolic shape. Use the 24-inch concave template as a guide.
6. For portable systems to be tripod-mounted, drill a hole in the center of the bottom lateral board to fit a ½-inch PVC pipe.
7. Seal and paint the wooden frame for weather exposure. I used three coats of marine spar varnish.
8. Staple the aluminum insect screening to the wooden form. Start with the center lateral board and then with a vertical line down the center. Staple outwards to get the mesh to conform to the parabolic shape, and trim excess mesh.
9. Attach brackets to the back of the frame for a tower mount or to make a wood-bearing assembly using ½-inch PVC pipe to secure the dish and tripod top together as pictured.
10. The feed horn can be mounted as shown. The focal point is 19.2 inches. The exact point should be determined experimentally using a beacon or field strength measurement.

...de N6XQ

73 Review by Marc Stern N1BLH

MFJ-1278 Multi-Mode Controller

Your inexpensive and easy way to the wonderful world of digital operation!

MFJ Enterprises, Inc.
Box 494
Mississippi State, MS 39762
PH: (800) 647-1800
Price Class: $250

Are you looking for one of the best bargains in data controllers today? You'll very likely find that with the MFJ-1278 Multi-Mode Data Controller. You can have a fully functional multi-mode controller that does everything other controllers do, for a minimum of $50 less.

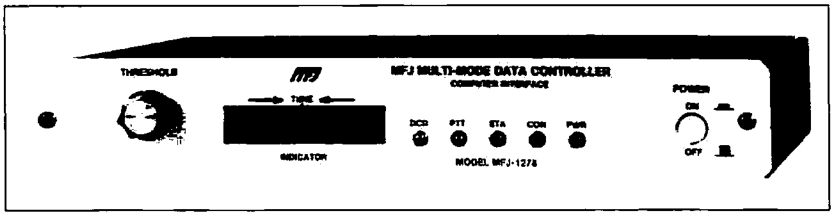

Photo A. The MFJ-1278 Multi-Mode Controller. This unit is an inexpensive way to get involved in a variety of digital modes.

Easy to Use

The MFJ is also worth a close look because of its simplicity and functionality. The front panel consists of five status LEDs, tuning LEDs, a threshold adjustment, and the power switch. That's about as basic a front as you'll find.

The rear panel is a lot busier. It has connectors for the RS-232 cable, TTL interface (if your PC uses it), speaker inputs for radios one and two, inputs for radio one and a 13.8-volt DC jack, and CW key input and outputs. The printer port is located on the left-hand side of the MFJ-1278, as you face the front panel. Some other data controllers on the market use a serial/parallel signal multiplexing arrangement which requires a custom cable. The 1278 makes life easier by separating the serial and parallel ports, so that you can use easily obtainable standard cables for each. The only disadvantage is unit placement on the console; you must set up the controller so that the printer port is free.

No-effort Updating

On the inside, MFJ uses a quality multi-layer PC board with plated through-holes. The heart of the MFJ-1278 is the nearly universal Z-80 CPU, used in just about every multi-mode controller on the market. Note, though, that there are very few discrete components. Everything is handled by Very Large Scale Integrated (VLSI) circuit technology. All the multi-pin ICs are socketed for easy removal. This makes the MFJ-1278 a snap to update.

For example, it was very easy to update my MFJ-1278 to the latest version of the firmware. All I had to do was remove four sheet metal screws, locate the IC indicated in the update documentation, and remove the IC from its socket. I used a small screwdriver and gently rocked the older firmware out. Then I straightened the pins on the new IC so that it would be easier to insert, and gently inserted it into the socket. After reconfiguring the jumpers to conform to the new firmware version, I closed it up. That was all there was to it; the part that took the longest was reinstalling the screws.

By the way, when you make this type of change, be sure to work in a static-free atmosphere. I use a grounded anti-static mat at my workbench, and I make sure that I am totally static-free before I begin. You can do this with an anti-static mat, bracelet, or strap. Whatever you use, be sure to keep static away from the IC device, otherwise you risk destroying it.

Unit Interfacing

Installing the MFJ-1278 is very easy. Since it uses standard cabling, you can use any RS-232 cable to link it to your personal computer or terminal. The MFJ-1278 is really a computer-in-a-box, and it does all the work. You don't have to have a computer; all you really need is a dumb terminal, and a keyboard for using the controller.

It's also easy to install the parallel port cable. MFJ uses a near-standard IBM-compatible printer port configuration, acknowledging the widespread influence of this giant computer corporation.

After you have installed the RS-232 and the printer cables (be sure the printer cable has a standard Centronics connector on one end, and the DB-25 on the other), hook up your radio or radios to the controller. MFJ supplies two multi-wire cables, terminated with 5-pin DIN connectors, for the controller. The unterminated end is for the radio. You supply the microphone connector.

To interface the radio and controller, all you have to do is follow the wiring diagram, which MFJ includes in your rig's manual, of the microphone cable. In the MFJ manual set, too, there's an appendix that lists the pin-outs of many common late-model rigs. You also have the option of building an interface cable that includes the audio input, or of building a separate cable for the audio input. MFJ offers a separate input jack to handle the audio from radios one and two. This is a multiplexed jack that requires a "stereo" plug. The PK-232 uses separate audio inputs for both radios.

Notice I said "radios." The MFJ multi-mode controller is capable of handling two radios, as opposed to the single radio of older TNCs. You can use your HF radio for HF RTTY, ASCII, AMTOR, Packet, or AMTOR/NAVTEX, and you can use your VHF radio for Packet or CW.

CW Feature

An interesting feature of the MFJ-1278 is its ability to send modulated CW, using audio frequency shift keying (AFSK). This means you can modulate your VHF FM rig for CW use. The controller turns the CW signal on and off at the microphone connector. This also means you can use your VHF radio for such things as over-the-air code practice. Speaking of code practice, you can set up the MFJ-1278 to act as a random code generator for upgrade practice. It automatically generates Farnsworth style CW.

Another nice feature of the MFJ-1278 is its ability to interface a CW key or paddle so that you can send by hand and use the controller as a memory keyer for contesting. Many other controllers let you use them only as your CW interface for the computer/keyboard. MFJ also provides various CW buffers to complement its CW keying feature.

Powering the MFJ-1278

You can roll your own coaxial power connector, using a negative sleeve and positive center, or you can use the wall supply that MFJ supplies. With the cables installed and the MFJ-1278 ready for operation, all that's left is to power it up. The multi-mode controller uses a common start-up configuration of 7 data bits, even parity, and one stop bit. With its autobaud feature, it automatically recognizes the speed that your personal computer or terminal is set up for, and it synchronizes itself after you tap several carriage returns. Using the straight-through cabling and any terminal program, you should see the MFJ-1278 sign on your screen. Then you can set the defaults to your specifications. The defaults include items such as your call, your special AMTOR call (set up with the MYSELCALL command), and various packet parameters.

MFJ supplies a Starter Pack (the MFJ-1282, MFJ-1284, or MFJ-1287, depending on your computer or terminal) with its own terminal program. The Starter Pack allows you to set up windows on your screen as send and receive areas. Another feature of the Starter Pack that I, being a thrifty Yankee, especially like, is its ability to print facsimile pictures to the screen as well as to the computer. It certainly saves a lot of paper to scroll through weather FAX pictures before printing them out. You can save FAX and SSTV pictures and print them later. The Starter Pack software is very friendly, easy to use, and worth buying.

Aside from the Starter Pack, the MFJ-1278 is easy to use in just about every other way. It features full-hardware HDLC, and it now offers a KISS interface so that it is compatible with the emerging TCP/IP protocol. It also is compatible with W0RLI/WA7MBL bulletin board software.

You may change operating parameters two different ways. You can use the SET command to display a menu of choices. After you've entered your selections, tap an X to exit, and you're done. The second way to change parameters consists of bypassing the menus by making a simple, mode change command at the prompt.

"(The MFJ-1278) does everything other controllers do, for a minimum of $50 less."

Interestingly, the unit implements just about everything in software, whereas many other controllers do everything in hardware. Each way has its pros and cons. Doing things via software (setting up Radio 2, for example), switches operation control from panel switches to the keyboard, centralizing control and reducing mechanical wear and tear. On the other hand, multiplexing the audio signal and having to use a "stereo"-style audio jack for separate audio inputs, seems to add to the complexity of things.

MFJ-1278 Performance

In action, the MFJ-1278 ranks with the best. For example, when I was copying AMTOR signals under very rough and noisy conditions, it stayed with the station until it faded totally from the picture as the band shifted. Of course, the number of retries did increase, but that's expected in this situation. Using the MFJ-1278 to receive FAX pictures was lots of fun and easy to do.

Tuning was easy, thanks to the wide, 20-segment tuning LEDs, and the large status LEDs allowed me to easily see what was going on. I tried all the modes and found the MFJ-1278 to be up to any task I asked it to do. It easily handled packet, AMTOR (Mode A, FEC, and Mode B), RTTY, HF ASCII, CW, HF packet, WEFAX, slow scan, and CW very well. It copied RTTY signals faithfully, under changing conditions, as it did AMTOR.

If you think I enjoyed using it, you are right. It was easy and fun to use, especially after I completed the firmware update. The Starter Pack was a good investment. Overall, I found the MFJ-1278 a very worthy device. It is worth considering if you want a good multi-mode controller at a reasonable price. You won't be disappointed! ■

Number 22 on your Feedback card

ASK KABOOM

The Tech Answer Man

Michael Geier KB1UM
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S. Burlington VT 05403

The Versatile VOM

First of all, thanks to Bob K9EUI, who wrote to point out a mistake (gasp!) in my February answer to "Headache #122". Bob said that the zener diodes should be in series, not in parallel. He is, of course, quite right. The diodes should still be connected "back to back"—that is, anode to anode or cathode to cathode; it doesn't matter which. Thanks, Bob.

Last month, when discussing troubleshooting, I referred to the use of an oscilloscope. A scope is the most important piece of test gear you can own, and any ham who can afford it should get one and learn how to use it. Though scopes can be pricey, almost *all* ham budgets can accommodate a VOM. This month's column, therefore, covers troubleshooting methods using only a VOM.

Analog Vs. Digital

The VOM (volt-ohm-milliammeter), or multimeter, is a remarkably versatile instrument. It certainly offers the most bang for the buck, with some models costing less than fifteen dollars! For serious troubleshooting, though, you should get a mid-range model, around the thirty or forty dollar mark, because it will have more ranges and be better protected against electrical abuse. Please note that I refer to a good ol' analog VOM, not a digital instrument. While digital VOMs (a.k.a. DMMs) offer more precision and accuracy, they are not very useful on changing signals. This even includes the more expensive ones with bar graph displays. A swinging meter movement will tell you things that no digital unit can.

Voltage Checks

The meter will tell you quickly whether power supply voltages are there. Don't be concerned if the reading is ½ volt off—VOMs are not meant to be that precise. But, if your 12 volt line reads 4 volts, you've got a problem!

In-circuit DC voltage readings can also tell you a great deal. If all three leads of a transistor show exactly the same reading, the part is probably shorted. If a transistor's base has a bias voltage on it, but the output at the collector or emitter is zero or the same as the supply voltage (and the lead being measured is not connected directly to ground or to the supply), the part is probably open. If a diode has positive voltage at the anode and nothing at the cathode, it is probably open. Note that these are generalizations, and specific circuits can act differently, but they are good guidelines with which to start looking.

Resistance Checks

Resistance measurements are also valuable, but they MUST be performed with the rig's power shut off and the power supply discharged. VOMs are very sensitive to abuse when in the "ohms" mode, and power applied to the leads will very likely ruin your meter.

When checking resistors, be sure to have the meter set for the range required to read the part in question, and always re-zero the meter after changing ranges. As before, don't worry about readings that are close but not exactly on, unless you are working on a high-precision circuit with 1% resistors. If a resistor reads open, then it is. If it reads lower than expected, then the part is probably OK, and other circuit elements are causing the misreading. To be sure, simply unsolder one leg of the resistor and measure it again.

Check diodes by setting the meter on the X10 or X100 scale. The part should read mid-scale in one direction, and open with the leads reversed. As with all in-circuit checks, false readings may occur due to other voltage paths. Just pull one leg and try again.

You can also check transistors. It's best to pull them first. Set the meter on the X100 or X1000 scale. The emitter and collector should read open (or nearly so) in both directions, with the base disconnected. The base and emitter should read like a diode: open one way and mid-scale the other. Tie the base to the collector, and the resulting part should also read like a diode. A bad transistor will typically have an emitter-to-collector short, or read open everywhere.

Don't read FETs and MOSFETs with a VOM, as the parts are very sensitive and easily destroyed. If in-circuit DC measurements indicate a bad part, substitute a new one to be sure.

Capacitors

Here's where an analog VOM really shines. You can check electrolytic capacitors quite easily. Pull one leg of the cap and set the meter to its highest resistance scale. Connect the capacitor's leads together with a clip lead for a few seconds to make sure it is fully discharged. Now, connect the meter across the cap, plus to plus and minus to minus. A small cap, such as 1 microfarad, should give a "blip" on the meter lasting a fraction of a second, then the meter should return to the infinity point. The bigger the cap, the bigger and longer the blip. A 1000 microfarad cap will give quite a swing, and settle slowly back toward infinity. A bad cap will give either no blip at all (if it's open) or swing the meter and not settle back toward infinity (if it's leaky or shorted).

A few words about this test: some meters are wired backward, and must be connected to the cap plus to minus. To check your meter, take an *expendable* known good cap and hook up to it plus to plus. If it reads leaky, discharge it and then try reading it plus to minus. If it now reads correctly, then your meter is indeed backward, and you must connect it plus to minus for all cap tests.

It's best to use a clip lead on one lead of your VOM for all tests, because the resistance between your hands can cause false readings, especially on cap tests.

Happy troubleshooting! Now, let's look at this month's letter.

Dear Kaboom,

I have a Heathkit Microlizer which used to work great with my Yaesu FT-101E. With my new FT-757GXII, though, I get severe white noise and RF feedback. I'm running both the Microlizer's and the radio's mike gains as low as possible but it still seems to be too much. Help, I can't take the noise!

Signed,
Hissed Off

Dear Hissed,

You've got a tremendous impedance mismatch! The Microlizer is a high-impedance device (50–100kΩ) and the '757, like most modern rigs, has a low-impedance (600Ω) input. If you can find one, perhaps in an old microphone, connect a matching transformer between the Microlizer's output and the rig. If you can't get one, try this: place a 47kΩ resistor in series with the output of the Microlizer, and then a 1kΩ resistor from the open end of the 47kΩ resistor to ground. Now connect the junction of the resistors to the mike input of the radio. If there's enough gain to work with, and I suspect there is, then that ought to do it.

Have a tech question? Send it off to "Dear Kaboom" at the above address.

Hamming It Up

Number 23 on your Feedback card

73 Review by Michael Jay Geier KB1UM

Kenwood TH-25AT

Pico-sized, mega-featured.

Kenwood USA Corp.
2201 E. Dominguez St.
Long Beach CA 90810
Price Class: $350 without CTCSS unit

Once I owned two 2 meter handhelds. The big one had the features, and the small one was, well, small. I vowed I would sell them only if somebody came out with a full-featured programmable unit as small as my little thumbwheel set. With the arrival of the TH-25AT, I made good my vow. I sold the two rigs, and bought the new Kenwood.

It's a Honey

It has most of the features of my old big rig, and yet it's nearly as small as the TH-21AT it replaced. Since today's handhelds have similar features, I won't expound on the joy of having memories, an LCD, and so on. Instead, I will discuss the specifics, both good and bad, which set this radio apart.

This rig has a rugged, solid feel, something I missed in the TH-21AT. It fits in my hand as if it belonged there, and It doesn't go "squish" if I squeeze it. The back Is a metal alloy (and heat sink for RF output, as in most new units), and the front is thick plastic. The ad claims the case is water resistant, and in fact, I have used the radio in a drizzle with no ill effects or signs of water penetration. The antenna is fat and substantial-looking, but very flexible.

Power Features

The LCD, mounted on top, is great for checking the frequency when the radio is in my shirt pocket. There's a lock switch to prevent accidental frequency changes, and two green LEDs light up the display at the push of a button. (Finally, no more incandescent bulbs!) The LEDs are surprisingly bright, making the display easy to read in the dark. A second push of the button shuts off the lights, or they will turn off by themselves after about five seconds. The LCD has a bar graph S-meter which also functions as a battery voltage indicator during transmit. This is a very nice touch, and far more useful than the usual RF output indicator.

A 600 mAh NiCd battery comes with the TH-25AT. With average use, it lasts a long time. A range of batteries is available, offering increased operating time or higher RF power output. With the optional AA battery case, an especially nice feature, I can always count on a spare battery.

The automatic battery-saver circuit further extends battery life. When there is no activity or key press for more than 10 seconds, the radio "goes to sleep." Every second, it wakes up for 200 milliseconds to check for a signal. I was bothered at first by the thought that I couldn't turn this feature off, but after using the radio a while, I can see it causes no problems. The most I ever miss is the first letter or two of a callsign. The battery lasts for days when I monitor a relatively quiet repeater.

As if that weren't enough, there's also an automatic power-off circuit which shuts off the rig after 59 minutes of inactivity. It also can't be defeated, and I expected to dislike this feature, too; but in practice it works out fine. The rig beeps to warn me of power down, and any key press will reset the timer.

Frequencies and Memories

In keeping with the overall sturdiness of the radio, the DTMF pad has resilient rubber keys. You can hear the tones while you send them. The pad is only for DTMF. You cannot enter frequencies or otherwise control the rig with it.

The unit receives from 141.000 to 162.995 MHz, which means you can listen to some public service channels, such as NOAA weather. (Yes, you can make it transmit out of band. No, I won't tell you how.) There are 14 memories, four more than most units have. Each memory holds frequency, offset (+, – or simplex), CTCSS frequency and status (with optional CTCSS unit), and even the status of the "reverse" switch! The rig automatically selects standard offsets according to the ARRL band plan, but you can override it, of course. The last two memories can hold odd splits, but you must know the repeater's input and output frequencies, since you can't enter an offset directly.

Frequencies, memories, and CTCSS tones are selected via the top-mounted rotary switch, in conjunction with the MHZ, VFO, MR (memory recall), and CTCSS buttons. In VFO mode, pressing the MHz button causes the rotary switch to step the VFO one MHz per click. Pressing it again returns the VFO to 5 kHz steps. It would have been nice if 100 kHz steps were also available, to avoid the monotonous (not to mention component-wearing) twirling of the rotary switch. Other radios using rotary switches work the same way.

In memory mode, the rotary switch steps back and forth through the memory channels. It's easier to do this with a knob than with buttons on a keypad. One very nice feature is the ability to copy the frequency from any memory to the VFO. Since frequency entry is somewhat inconvenient, this can really save

time and effort when you want to set the VFO to a frequency near one already in memory.

During CTCSS entry, the rotary switch steps up and down through the CTCSS tones, with each tone's frequency displayed on the LCD. It couldn't be easier. Of course, the optional CTCSS unit is required for this to work.

Scanning and Memory Lockout

Limited memory and band scan functions are provided. When a signal is detected, the scanner pauses for a few seconds, then resumes scanning. There are no other choices. It would be handy to be able to set limits. Some compensation is provided by the radio's ability to scan in either direction. A twist of the rotary switch lets you change scan direction at will, so, if you watch the LCD, you can change direction when the frequency goes out of the ham band, and scan back through it.

Memory lockout is available and easy to do. When scanning memories, for example, I lock out the weather channel to avoid the rig's stopping there each scan; that's what lockout

is for. Unfortunately, it is also locked out of manual selection, so that I must unlock it before I can listen to it again! Again, other rotary-controlled rigs work the same way.

TH-25AT on the Road

Walkies, of course, are not intended to be mobile rigs, but many hams use them that way to avoid the cost of yet another radio. Although some full-sized walkies aren't bad for this purpose, the TH-25AT is difficult to operate while driving. Many functions, from memory entry to DTMF dialing, are impossible to do with one hand. Plus, that top-mounted LCD, so great for shirt-pocket use, can't be seen when the radio is lying flat. Oh well, I guess you can't have it all!

Nit-Picks

The TH-25AT is great, but what can't be improved upon? The track into which the battery slides is plastic, unlike the metal ones used by other manufacturers. It allows the battery to wobble a little, and mars the rig's otherwise rock-solid feel. Mine also shows some shedding of the plastic after a few months, which could eventually loosen up the pack enough to lead to intermittent powering of the rig from the pack. Finally, the slight movements of the AA cell pack cause crackles in the receiver, indicating poor contacts. (It doesn't happen with the NiCd pack.)

Like other small handhelds, the audio amp is puny and so is the speaker. The amp seems to clip at an even lower volume levels than my TH-21AT did. In noisy environments, it can be hard to hear the rig.

Although the transmitter will produce 5 Watts with 13.8 volts applied, there is no DC input jack. You must buy an adapter which slides on in place of the battery.

There is no priority alert function. It was nice with the old rig to be able to monitor two frequencies at once while waiting for a friend to call.

Although sturdy and well protected, the PTT switch is hard to press, and makes my finger hurt after only a short while. Also, there's a fairly strong birdie in the receiver from 156.190–156.200, which will pause the scan. I checked with some friends in other states, and theirs had it, too. It is, however, well out of the ham band, and thus not too important.

"The unit receives from 141.000 to 162.995 MHz, which means you can listen to some public service channels, such as NOAA weather."

If the CTCSS receiving function is on and the received signal is not sending CTCSS, the scan will pause even though the audio will remain squelched. Why? Also, it's impossible to set the transceiver to receive CTCSS without also being set to send it.

The S-meter display has 10 small segments and one big one, suggesting an 11-step display. But the small ones always come on in groups of two, so it's really a six-step display. This is also true of the battery voltage indication, so its resolution is rather limited. Finally, varying S-meter readings cause soft clicks in the receiver, especially on weak signals.

Calling All Manufacturers

Which brings up my final suggestion to all ham radio manufacturers: Put the lithium batteries in holders, so that we ourselves can change them! Why make us send the radios in for repair every five years just to replace a battery?

Conclusion

Even including these minor grievances, this is the best walkie I've ever owned. It feels good and works well, and keeps useless features to a minimum. It does nearly everything I'd want my "dream rig" to do, and it's small enough to take anywhere. I intend to keep it for a long time! ■

Number 24 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell PE K0OV
PO Box 2508
Fullerton CA 92633

Selecting Polarization

In previous columns, I explained why your VHF transmitter hunting antenna should have the same polarization as the antenna used by the hider. If your hunting antenna has the wrong polarization, the directly propagated signal will appear to be much weaker. Worse yet, reflected signals from terrain features can appear stronger relative to the direct signal, resulting in false bearings.

Unless hunt rules restrict the hider to a specific polarization, your RDF antenna should be adjustable for horizontal and vertical polarization, and, if possible, for everything in between. Dopplers and some switched-antenna RDF sets can't change polarization, but it's easy with quads and beams.

Antenna Setups

When you set up for T-hunting with an aluminum yagi, make provisions for easy turning of the boom to select polarization. Some long Cushcraft beams have mast-to-boom plates like the one in Photo A. If yours doesn't, make your own with U-bolts and an aluminum plate from a hardware store. U-bolts should be snug, but not so tight that the boom can't be turned by hand. Don't forget the lockwashers.

If you prefer a PVC and fiberglass quad for fox-finding, make a slip joint for changing polarization by using the technique of Photo B. The ½" PVC boom goes through the ¾" x ¾" x ¾" slip tee fitting, which is slotted with a saw cut through the top. Thin rings of PVC material, cemented over the boom on each side of the tee, keep it from sliding. An automotive hose clamp adjusts tightness.

It takes only a few seconds to get out, reach up, and twist the antenna from horizontal to vertical or vice versa. Be sure to dress the feedline with a bit of slack to accommodate the boom rotation. A ½" x ½" x ¾" tee is harder to find, but it eliminates the need for PVC rings. Just split the top with a saw and force the boom through, reaming out the inside of the tee slightly if necessary.

Clarke Harris WB6ADC uses a clever arrangement that allows him to change polarization of his quad by reaching out from inside his van and pulling strings. The strings rotate the boom 90 degrees back and forth, with mechanical stops at horizontal and vertical polarization positions.

Crossed Yagis

Electronic polarization switching is even better than mechanical methods. It's perfect for hunting in bad weather, since you don't have to reach out or get out to twist the antenna boom. Several crossed yagi antennas are available commercially for OSCAR work.

The Cushcraft A144-10T has 10 elements, five for each polarization, with a gamma match on each driven element for direct connection to 50Ω lines. You can mount the antenna with elements horizontal and vertical, and bring a separate coax line for each driven element down to a two-way coaxial switch near the driver's seat.

The following scheme is much more versatile, and has been used successfully in many hunts (and many wins) by Vince Stagnaro WA6DLQ. He adapted it from work done by British VHF DXers, which was described in the *RSGB VHF/UHF Manual*. A six-position rotary switch selects among four linear polarizations and both senses of circular polarization.

WA6DLQ's crossed yagi antenna is home-built from two KLM model 144-148-4 antennas, as shown in Photo C. To make the conversion, remove all elements from one of the KLM antennas and mount them on the boom of the other antenna at exactly right angles to its existing elements. Added elements must be as close as possible on the boom to their cross-polarized counterparts, and original element spacing must be maintained.

The KLM antennas use folded dipole driven elements with 4:1 coax baluns to match 50Ω feed lines. Assemble the two baluns per KLM's instructions and connect them to the driven elements according to the inset in Figure 1b. The inner conductors of the coaxes to the switch box go to the top terminals on the driven elements. Driven element #1 is forward of driven element #2 on the boom.

Photo A. An aluminum plate and U-bolts at the boom-to-mast joint allows rotation of the boom to change polarization.

Why place the elements at a 45 degree angle to the boom instead of one set horizontal and one set vertical? Vince did it this way to allow use of a metal mast. If one element set were vertical, it would interact with the metal mast, degrading the directional performance. Moreover, this method keeps the lower tips of the antennas higher above the car roof.

The Switcher Box

The Minibox housing the switch must provide plenty of room for the phasing lines. BNC receptacles are best for the three connectors, but you can also use SO-239 UHF types. Mount them so that their center contacts just touch the wiper arms on the switch decks (see Photo D) and solder them in place.

Select your rotary switch for good RF performance. Check swap meets and surplus sources for switches specially designed for RF use, with 60 degree detents instead of the typical 30 degrees. Because of the critical lengths of the phasing and matching lines, your switch box will work on only one band, just like the cross-polarized yagi. WA6DLQ's setup is for two meters, but you can make a switcher for another band by scaling coax jumper lengths by the inverse ratio of the frequencies.

The quarter-wavelength 75Ω lines are impedance transformers to allow paralleling two 50Ω antennas and feeding the combination with 50Ω line. The quarter- and half-wavelength 50Ω lines provide 90 and 180 degrees phase shift, respectively, for polarization selection.

Small coax such as RG-58 (50Ω) and RG-59 (75Ω) also works for the phasing/matching lines. You can even use smaller coax such as RG-174 (50Ω) and RG-179 (75Ω) between the switch gangs. The lines are so short that loss is not a problem. A foot of RG-174 has only 0.15 dB loss at two meters.

Don't use RG-174 if you have a high power transmitter or amplifi-

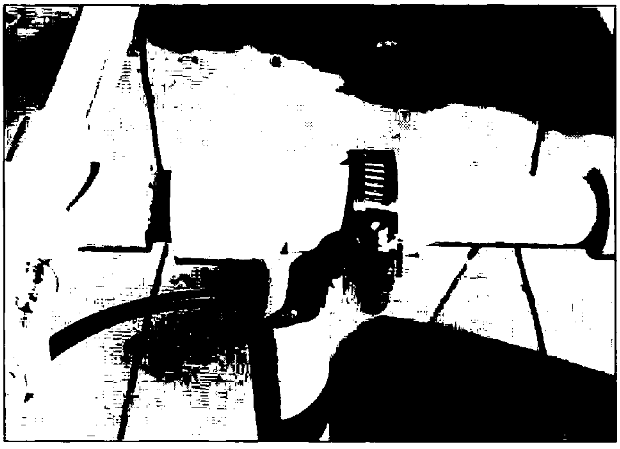


Photo B. Slip joint for PVC quads. The hose clamp adjusts the tightness.

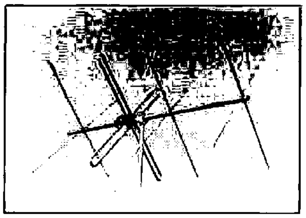


Photo C. The multiple-polarization yagi is made from two KLM beams. Note that element sets are at 45 degree angles to the mast.

er—it's rated at only 45 Watts maximum at two meters. Vince used RG-122 (50Ω) and Belden 8280 (75Ω), which are larger than RG-174 but smaller than RG-58. They handle reasonable power and are easy to wire in.

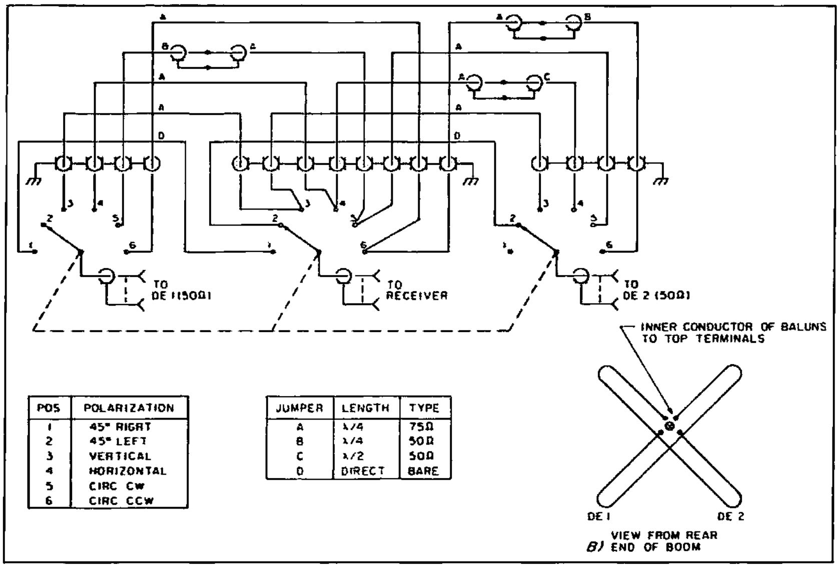
See Figure 1a. The solid-dielectric coax types mentioned above have 69.5% velocity of propagation. Quarter wavelength lines (90 degrees phase shift) are 13¼" and the half-wavelength line (180 degrees phase shift) is 26½" long. Cut eight quarter-wavelength lines from 75Ω coax ("A" jumpers), two quarter-wavelength lines from 50Ω coax ("B" jumpers), and one half-wavelength line from 50Ω coax ("C" jumper).

I don't recommend foam dielectric coax for phasing lines, because its velocity of propagation changes the lengths. A typical factor for foam coax is 75%, but it varies. You can determine the correct value for your coax from tables in handbooks and catalogs, and scale the lengths accordingly, or you can cut the lines to resonance with a dip meter. The two D jumpers are short pieces of bare wire going directly between the appropriate switch terminals.

Strip the braid back ½" and the dielectric back ¼" on each end of the coax jumpers. The center conductor of each line goes to the switch lug, and the braid goes to a ground ring made of copper bus wire surrounding the switch decks, as shown in Photo D.

In three places, a transformer line and a phase shift line must be connected in series between switch decks. Do not use connectors at the junction of the two cables. Remove the jacket ½" from each end and retract the braid. Solder the center conductors together and tape over that junction. Then smooth the braids together over the tape, wrap some fine bare wire over the junction, and solder carefully and quickly. Cover the whole joint with electrical tape or shrink sleeving.

Use low-loss foam coax such as RG-58X for the two lines between the switch box and the antenna-driven elements. The incoming wavefront at the two antennas must arrive at the switch box inputs at exactly the same instant. Therefore, the two lead-ins must be the same length, except to correct for the distance between the driven elements on the boom. For example, if DE1 and DE2 are exactly one inch apart on the boom, make the lead from DE2 exactly ¾" (Remember the velocity factor!) shorter to provide this compensation.



POS	POLARIZATION
1	45° RIGHT
2	45° LEFT
3	VERTICAL
4	HORIZONTAL
5	CIRC CW
6	CIRC CCW

JUMPER	LENGTH	TYPE
A	λ/4	75Ω
B	λ/4	50Ω
C	λ/2	50Ω
D	DIRECT	BARE

Figure 1. (a) Schematic diagram of the polarization switcher box. (b) The baluns that connect to the driven elements are 4:1.

Outguessing the Hider

A multiple polarization antenna system is a big help when hills and buildings cause signal reflections and multipath. At the start of the hunt, check all directions and all polarizations to find the strongest and clearest signal, using your S-meter if the signal is strong enough. If not, use your noise meter if you have one. (If you don't have one, don't despair. There will be one in this column soon.)

In situations when there are nearly equal signal strengths in more than one linear polarization position or in more than one direction, the bearing with least flutter and fewest fluctuations is probably the direct signal.

Some hunters have noticed that horizontally polarized signals have much less polarization shift as they knife-edge over hills and bounce back from them, compared to vertical signals, which readily shift and sometimes appear to go circular. But don't consider this a hard and fast rule.

A linearly polarized signal will appear to be about 3 dB weaker in the circular switch positions. Likewise, a circularly polarized signal will appear to have nearly equal strength in the four linearly polarized switch positions, and will be about 3 dB stronger in the correct circular switch position.

Check polarization frequently through the hunt, particularly as you go over hilltops. What appears to be a 45-degree or circularly polarized signal at the starting point may turn out to be something completely different as you close in. Polarization will be correct only when the signal is exactly "on axis." Signals from the side and rear of the antenna often produce incorrect polarity indications.

Even if your antenna system switcher is built perfectly, your receiver input impedance is probably not exactly 50Ω over the entire band. This mismatch between the antenna system and the receiver can occasionally cause incorrect polarization indications with this switching system. This is not a practical problem in transmitter hunting, but it will cause errors if you try to use the antenna system for serious propagation studies or laboratory-type instrumentation. The mismatch can be masked by switching in 10 dB or so on your attenuator when polarization measurement accuracy is important. (You do have a 50Ω impedance attenuator, don't you?)

One last caution: don't turn the selector switch while transmitting. Good luck, and come back next time for ways to support your antenna mast. Get ready to drill that big hole in the car roof!

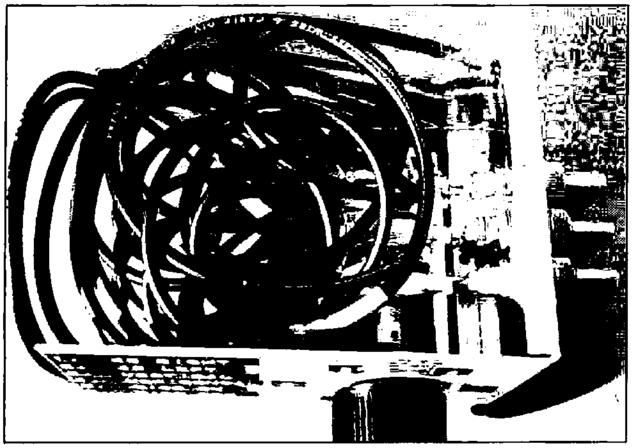


Photo D. Inside view of the switcher box, showing the three-deck ceramic switch with wiper lugs soldered directly to the BNC jacks.

Number 25 on your Feedback card

HAMSATS

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
14714 Knightsway Drive
Houston TX 77083

Satellite Activities

During 1989, AMSAT NA is promoting events, contests, and operating activities via AMSAT-OSCAR-13. The satellite is a limited resource, so activities which can overload the transponders and cause battery degradation are avoided.

ZRO Test

The ZRO Technical Achievement Program or "ZRO Test" began on A-O-13 in mid-January after successful reorientation of the satellite. This activity is a test of operating skill and equipment performance. The tests can only be run when the satellite-pointing angle provides uniform signal strengths within the satellite's footprint.

During a typical ZRO Test, a control station sends and repeats numeric code groups at gradually reduced power levels (3 dB each time). Participating operators measure the sensitivity of their systems by monitoring and recording the contents of the transmissions. Those who can copy the satellite's beacon can copy level "zero" of the test. The challenge is to copy the lower power-level transmissions.

All satellite enthusiasts are invited to listen to the A-O-13 ZRO Tests. The downlink frequency on Mode B (70 cm up and 2 meters down) is 145.840 MHz. Mode L (23 cm up and 70 cm down) ZRO Tests will be scheduled later in the year. All transmissions are CW at 10 wpm. Check the AMSAT Nets and Packet bulletins for schedules and updates. Other background information can be found in the November 1988 "Hamsats" column and "Satellite Awards" by WB5RMA in the May 1988 issue of *73*.

Operating Milestones

AMSAT NA has issued certificates to all those who made contacts with specified stations on A-O-13's first day of operation. Other operating events under study include a foxhunt (hidden transmitter hunt) via satellite, and one- or two-hour sprints similar to those on the HF bands.

Dave Guimont WB6LLO prefers events corresponding to milestones in a satellite's life in orbit. The opening day of general transponder use on A-O-13, July 23, 1988, was such an event. Dave began his pursuit of such milestones five years earlier on August 7, 1983 with opening day on AMSAT-OSCAR-10. Table 1 lists contacts Dave has made during noteworthy days in A-O-10's life.

The launch date, first operations day, apogee equator crossings, and maximum northings and southings are among significant events in the life of an amateur satellite. The apogee's sub-latitude position outlines a cyclic path on the surface of the earth as determined by orbital parameters. In the case of A-O-10, the complete cycle takes approximately three years and nine months. WB6LLO has completed a contact at each of these events. A-O-13 takes about 20 years to complete the same cycle. Those who made contacts on A-O-13's "opening day" have begun their own quest for operating milestones via satellite.

The equator crossings and the extremes of latitude Dave pinpointed in Table 1 were determined by 30-second "bracketing" during an applicable five minute period. An IBM PC with an AMSAT satellite tracking program and the latest NASA orbital predictions were used for the computations.

A-O-10 was in service during all of the events. It will hopefully also be in operation during October 1989, the estimated time of the next southernmost apogee.

This effort is not presented as some phenomenal achievement. The same results can be duplicated by the most modest satellite station. It merely indicates one of the many activities that are a part of operating one of the most sophisticated forms of amateur radio. How many operators will be "on frequency" for the next southernmost apogee of A-O-10, or the first northernmost apogee of A-O-13?

Antennas and Antenna Systems

While winter in much of North America has forced hams to put aside antenna projects, this is sometimes the best season for outdoor work in South Texas. Summers can be oppressively humid and hot.

Antenna systems for satellite chasing can be simple and inconspicuous, yet provide excellent results. A recent antenna party at W5EBH provided an opportunity to get some pictures of a system as it was put together.

In the January "Hamsats" column, I noted several antenna systems that active satellite operators prefer. The quad used by Blake W5EBH on 2 meters is not typical, but it was available and provided satisfying contacts. The 70 cm antenna is a KLM 18C with polarization switcher.

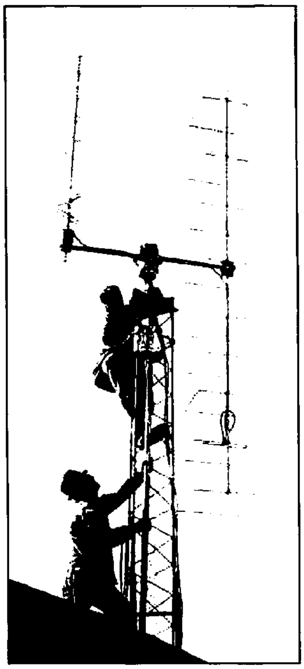


Photo A. KA5ODO and N5LKJ position the satellite antennas.

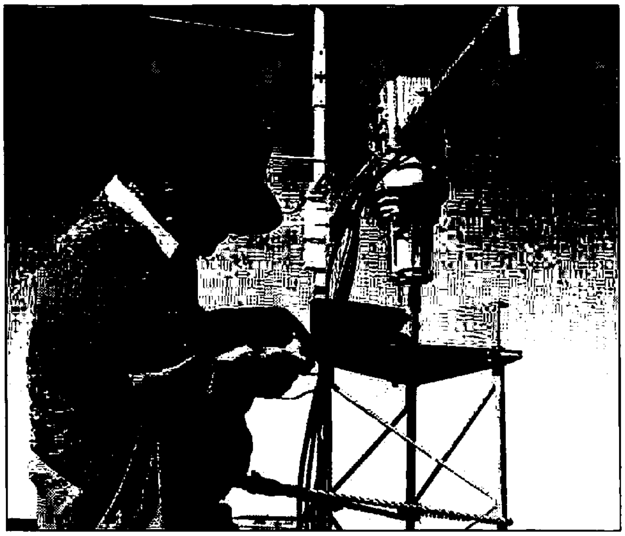


Photo B. KA5ODO secures the tower top plate for the array.

Blake carefully checked the wiring for the Yaesu/Kenpro rotators. It is very easy to invert rotator orientation or mis-wire the system, with two units and control lines involved. Take note of this: Carefully check your system on the ground and label all lines, including the coax.

Since satellite antennas only need a good view of the sky, they don't need much tower. The structure in Photo A is just high enough to allow the antennas to look over the top of Blake's roof. From the street they are not even visible.

A typical HF yagi is a two-dimensional antenna. When put together, it will lie flat on the ground. Satellite antennas designed for circular polarization are three-dimensional. They are bulky and can be difficult to transport to the top of any structure, especially a tower with guy wires. Blake did not have guys, but a hoist was used for safety, and it did make installation easier.

For a satellite system, the azimuth rotator can be mounted inside the tower or supporting structure, but the elevation rotator must be in the clear. In this case, however, the complete system was mounted to a custom-made plate on the top of the tower.

Many satellite enthusiasts use Belden 9913 coax for their antenna installations to keep line losses low. If run around the rotators, make sure to keep a generous

loop of this cable around the rotators (see Photo B) to keep rotational stress low. The 9913 cable has a foil shield that does not twist well. Any twisting of the cable near a connector may cause the connector eventually to fail, due to the shield detaching, or the whole cable working loose of the assembly.

After a few hours of work in Blake's back yard, the antennas were up and the cables secured and fished through the attic. Does it work? You bet! Although its appearance is strange, the array is balanced and it performs well on Modes B and J (2 meters up and 70 cm down).

Updates

RS-10/11 continues with Mode A (2 meters up and 10 down) seven days a week. Mode K (15 meters up and 10 down) has been activated simultaneously with Mode A on some weekdays.

Fuji-OSCAR-12 has been activated for very limited operation. Operating schedules can be found on the AMSAT nets and also via the bulletins on UoSAT-OSCAR-11 (1200 baud Bell 202 format). Extended schedules are subject to change, but have been posted on the F-O-12 BBS during Mode JD (digital BBS) operating times.

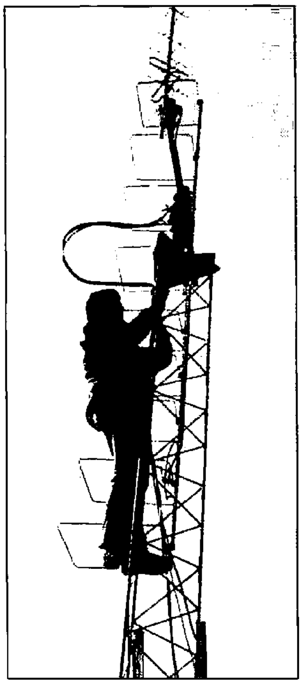


Photo C. WA5ZIB puts a generous loop in the feed/rotator lines from the antennas to the tower.

After a few months of great operation, A-O-10 is back in hibernation. When the solar panels are not properly illuminated, operation via this veteran satellite is suspended. Watch the AMSAT Nets for updates.

A-O-13 continues with exemplary coverage and activity. Proposed operating schedules were presented in last month's column. The ground control stations attempt to adhere to predicted operating itineraries, but minor modifications are common. Mode S operation is the most difficult to predict.

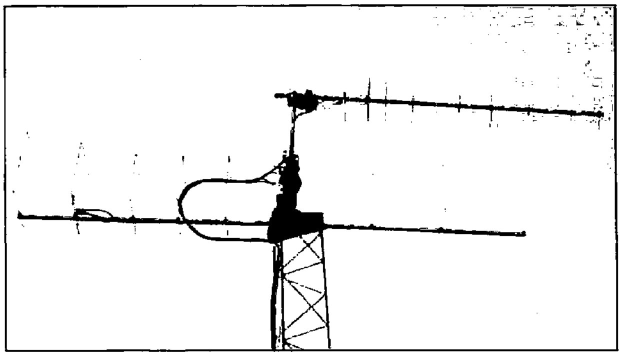


Photo D. The finished satellite antenna installation at W5EBH.

From The Log of WB6LLO

Event	Date	Time	Orbit#*	Station**
Initial contact	7 AUG 1983	0030Z	112	WA5ZIB
1st North most	19 MAY 1984	2000Z	701	KB7RV
1st Equator cross	1 MAR 1985	0850Z	1352	DK2LM
1st South most	28 FEB 1986	1815Z	2043	VE3ER
2nd Equator	27 JAN 1987	0021Z	2727	W2PAV
2nd North most	5 JAN 1988	1006Z	3433	VK7ZBX
3rd Equator	11 DEC 1988	0935Z	4135	VE5XU

*The Orbit adjusted to conform to NASA variations.
** One of the several stations contacted.

Dx

Number 27 on your Feedback card

Hams Around the World

Tom Gregory N4NW operating TN4NW from Brazzaville, Congo, using WB2DND's computer logging program.

Chod Harris VP2ML
PO Box 4881
Santa Rosa CA 95402

TN4NW DXpedition to the Congo

"I wanted to put a country on the air that hadn't been on for a long time." So Tom Gregory N4NW began the description of his TN4NW DXpedition to the Congo at DXPO 88 in Washington, DC.

Tom is a member of the US State Department, and has been stationed in Africa for the past several years. During his travels around the Dark Continent, Tom visited about half the countries in Africa, and obtained amateur radio licenses and operated from many of these. But most of these countries were the more common ones; he had been unsuccessful in activating a very rare country. But not through lack of trying!

Chad TT is one of the rarer countries on the amateur bands. Tom had frequently visited that country and talked to the telecommunications officials about obtaining permission to operate. The officials were happy to give him verbal permission, but no one was willing to issue a written license. Since the DXCC desk would not accredit an operation from Chad without written proof of operating permission, Tom had to look elsewhere for his DXpedition to a rare country.

Tom's current assignment is with the embassy in Kinshasa, the capital of Zaire. Directly across the Congo River lies Brazzaville, the capital of the Congo. Zaire was certainly not rare, as it ranked only 99th in *The DX Bulletin*'s 1987 "Most Wanted Countries" survey. Tom alone had made 40,000 contacts from Zaire as 9Q5NW, and there were several other active amateurs in the country. But the Congo was another story.

Amateur operation from the Congo has been scarce since the early 1980s. In fact, the Congo ranked 36th on the "Most Wanted" survey in 1987. The lure of a rare country within sight of his home prompted Tom to seriously pursue an amateur license for TN.

Tom's work took him to Brazzaville on a regular basis, and he used his embassy contacts to begin the long task of obtaining written operating permission. In April 1987, he sent his application for a license to the Congo PTT, which forwarded it to the DSGE, the state security arm of the Congo's government. Through the US embassy, Tom continued to track progress of the application, and was finally able to win an appointment with the Director General of Communications. During the interview, conducted in French with an interpreter, the Director quizzed Tom on his background, military service, his job at the embassy, and more. Apparently satisfied with Tom's responses, he agreed to provide an amateur license, once Tom paid the application fee.

"How much is the fee?" Tom inquired.

The official responded with an outrageous, and obviously arbitrary figure, "200,000 Central African Francs," or over US$300. Tom gulped, excused himself to return to the US embassy for the money, and immediately returned with the cash. The month was February 1988.

In May, Tom had still not received the license. He was concerned over the lack of response. His wife was seriously concerned. Inquiries finally pried the license out of the PTT: TN4NW, valid for six months, and renewable. Tom immediately made plans to operate from Congo.

TN4NW On The Air

There are two ways to cross the Congo River: by the ferry Matadi, with the goats, chickens, and overcrowded conditions; or by private boat, for considerably more money. With more than 600 pounds of radios, computers, antenna, and tower, Tom elected to take the private craft.

On the weekend of June 30, Tom hauled his gear to the home of the secretary of the American Ambassador in Brazzaville, who had offered the use of her house as a base for TN4NW. Tom quickly set up his 40 foot tower and tribander, and plugged his donated ICOM IC-761 into a power conditioner designed to even out the surges and peaks that can destroy sensitive electronic gear. A portable Compaq computer performed ail logging functions, running WB2DND's logging software. Tom backed up the computer memory with a hard copy printout in case something happened to the computer hard disk.

The operation was highly successful. That weekend Tom logged 8,056 QSOs with 5,700 different stations, giving thousands of DXers their first shot at the Congo. A subsequent trip in November logged thousands more. Tom made an effort to repeat each callsign, to eliminate ambiguity, and to reduce insurance contacts. However, the many requests for contacts on other bands, such as 40, 80, and 160 meters, were a great time waster. His license was not valid for 160, and the low bands are very noisy in tropical Congo, due to the constant thunderstorms. Despite the occasional abuse by over-anxious DXers, Tom continued with his game plan to give as many DXers as possible a new country.

Unfortunately, this DXpedition was not without considerable monetary cost. For each time across the river, despite the relatively short distance, Tom had to pay $77 in boat fees, and a hotel bill totaling hundreds of dollars. Plus, in compensation for the donation of operating space, Tom felt obliged to take the ambassador's secretary out to dinner, to the tune of about $200. Even a lowly beer costs $11 in Brazzaville!

Having Brazzaville within sight of his home in Zaire has prompted Tom to raise an interesting question. If he set up a remote VHF link from his QTH in Kinshasa to the HF station in Brazzaville, would the TN4NW QSOs so obtained count for DXCC? The station and operator would both be appropriately licensed, and the HF station would be in the Congo. It would be similar to having a very long microphone cord. If a shipboard operator sticks his antenna on the shore, it counts as a land-based station; why should a VHF link be any different? An intriguing question that the DX Advisory Committee may wish to explore soon.

Tom Gregory's Comments

Tom N4NW added some more comments recently: "The logistics of crossing to Brazzaville and remaining there a number of days for operation of TN4NW are almost overwhelming. On top of the cost of travel, and hassles with border officials, there is the daily expense of living in Brazzaville. However, I can overcome the costs, with the support of DXers worldwide, and overcome the hassles with border officials. What I have not been able to overcome is the poor operating practices on the part of a number of hams, particularly those In some of the Southern and Eastern European countries. On top of these poor operating practices comes the addition of American hams who continuously request frequency changes, mode changes, and schedule information. I ask hams, what happened to the practice of listening and working the station when and where he is, and listening to determine what is planned for other times, frequencies, and modes?"

The WB2DND Logging Program

Many DXers working TN4NW were surprised when Tom said that they had already worked on this band. The speed at which he came back with this information obviously precluded any paper duping method. Tom used a logging program especially designed for his needs by Don Greenbaum WB2DND.

Tom wanted a logging program to accomplish the second of his goals. After putting a rare country on the air, he wanted to give a new country to as many DXers as pos-

sible, and only secondarily to provide added band or mode QSOs. He also needed a computer logging program that would greatly simplify the task of the QSL manager.

The WB2DND program accomplishes these goals very well. The program includes a master log, containing all contacts made, and provision for "current" logs, very useful for contest work. Once a log is selected from one of the on-screen menus, the DX operator can log online, entering only the callsign, and report, if desired. The program picks up the date and time from the computer system clock and enters band and mode data from the last contact.

If the callsign entered is already in the log, even on a different band or mode, the program flashes this information on the screen. The operator has a choice of deleting the OSO as a dupe, or logging a new band or mode. All this happens with lightning speed on an IBM PC or compatible computer. WB2CHO used the program in the ARRL SS, and many contesters were amazed that by the time they had finished calling, he could come back with: "We've already worked at 1123Z yesterday, you're number 35." Dupe data appears on the screen essentially as fast as you can type.

The WB2DND program also permits the user to edit entries, generate printouts in various forms for contest logs or dupe sheets, backup to the floppy drive to protect valuable log data, and QSL instantly. To QSL a contact, one enters only the callsign; the program then displays all contacts with that station. At the touch of a key, the program prints QSO data labels for that station, which can be affixed to the QSL card. So what if the incoming card has the wrong date, time, mode, or band! The program will locate every contact with that callsign, and print all labels in seconds. A great boon for the over-worked QSL manager!

The WB2DND logging program was designed to meet the needs of Tom Gregory and his QSL manager; it is not an all-purpose program. The data entry is fine for contest-type running, but cumbersome for hunt-and-peck DXing. The operator has to know the names of all logs; they aren't displayed on the screen for easy selection. And editing entries is slow and awkward. The program will locate partial callsigns, but only from the beginning of the call. For example, it will find WA4TDG if you type WA4T, but not if you enter TDG. Also, it is not designed to track multipliers or score in contests. However, DXpeditioners and some contesters may find it very useful. As mentioned above, WB2CHO used it in the ARRL SS with great success. It's easy to keep track of the 76 multipliers in SS on a piece of paper. All files are compatible with dBASE III.

The WB2DND Amateur Radio Log Database is available for $25 from Don Greenbaum WB2DND, 250 Standish Street, Duxbury MA 02332. Specify if you have a hard disk or color monitor. A minimum of 512K of memory (RAM) is required to run it.

Only partly tongue-in-cheek, Tom continues: "A new feature being added to the WB2DND logging program in use at 9Q5NW and TN4NW is the 'lid' function. By using the 'lid' function, the program will flag all logged contacts for that station in the data base. When using the 'lid' function, calls previously flagged have a second flag added, and that call can no longer be added to the log. Indications are displayed on the monitor as to the 'lid' status of the callsign to alert the computer user of the 'lid' status of that station, to remind the DX station not to reward this 'lid' with a QSO. I hope to supply a list of these 'lid' stations to the DX newsletters so other DXpeditions can immediately identify the 'lids.' My QSL manager, AL7EL and I have an agreement: I make the contacts, he takes care of the QSLs. I have no way of determining, without asking the manager, the status of any QSLs. So, if you want to know about your QSL, contact the manager."

Tom continues, "AL7EL is the primary manager for 9Q5NW and TN4NW.

However, as AL7EL's address is not valid in Callbooks prior to 1988, some stations may wish to send their cards for these stations to KC4NC or N4NW (my home call), which is valid after the 1986 Callbook. All QSLs should still be sent to the Callbook address whenever possible.

Also, avoid use of the bureau. The only valid bureau address is N4NW. Cards sent via bureau will be processed by me upon my return to the US, scheduled for October 1989."

Number 28 on your Feedback card

NEW PRODUCTS

Compiled by Linda Reneau

PRODUCT OF THE MONTH

PACCOMM PACKET RADIO SYSTEMS

PacComm TNC-225

The PacComm TNC-225 packet controller, with Z-80 microprocessor, 32K EPROM, 32K RAM, and full duplex 8530 HDLC controller, is a new design built on the popular features of the TNC-220. Major features include: dual modems to support 1200 baud VHF/UHF and 300 baud HF operation; HF tuning indicator with multicolored bargraph LED display; port for PacComm's 9600 baud FSK modem and satellite modems; personal mailbox at no charge; fifteen front panel status LEDs; and provision for AMTOR and RTTY modes with upgrade EPROM.

The TNC-225 uses the TCM3105 modem IC for VHF, and the EXAR 2206/2211 ICs and 6-pole active filter for HF operation. Firmware supports TAPR 1.1.6 command set, including KISS and enhancements.

Price, $189.95 fully assembled and tested. Comes with operating manual and cable connectors. Thirty-day return privilege, 1-year warranty. *PacComm Packet Radio Systems, Inc., 3652 W. Cypress St., Tampa FL 33607-4916. Technical information: (813) 874-2980. Toll free order: (800) 223-3511 (except Florida). FAX: (813) 872-8696.* Circle Reader Service number 201.

CREATIVE CONTROL PRODUCTS

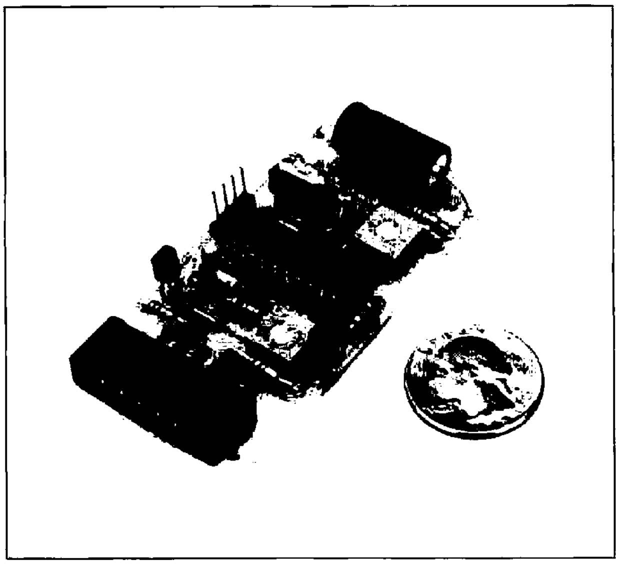
The UAI-20 Universal Audio Interface board, a repeater and link audio mixer from Creative Control Products, features a CTCSS Decode, DTMF Mute, and link Monitor-Mix control.

Audio inputs consist of repeater, link, control receiver, CW/Tone, CTCSS Tone, and auxiliary input. Audio outputs consist of repeater, link, and DTMF. Control inputs consist of repeater COS, CTCSS Mode, DTMF mute, and auxiliary.

The CTCSS Decode logic level is selectable high or low. The UAI-20 has provisions to mute the DTMF tones from the repeater transmit audio via a jumper on the circuit board. Inside of the UAI-20 is an audio filter which removes the sub-audible tone from the repeater receiver audio path. Automatic muting occurs when the selected (by configuring the 6-position DIP switch) CTCSS tone hasn't been decoded.

Full audio is normally present. When the repeater COS is activated, both the repeater and link audio are mixed, resulting in the condition called Monitor-Mix, which is adjustable. When auxiliary control input is activated, link receive audio is muted upon repeater COS activity. Mute and Monitor-Mix are selectable.

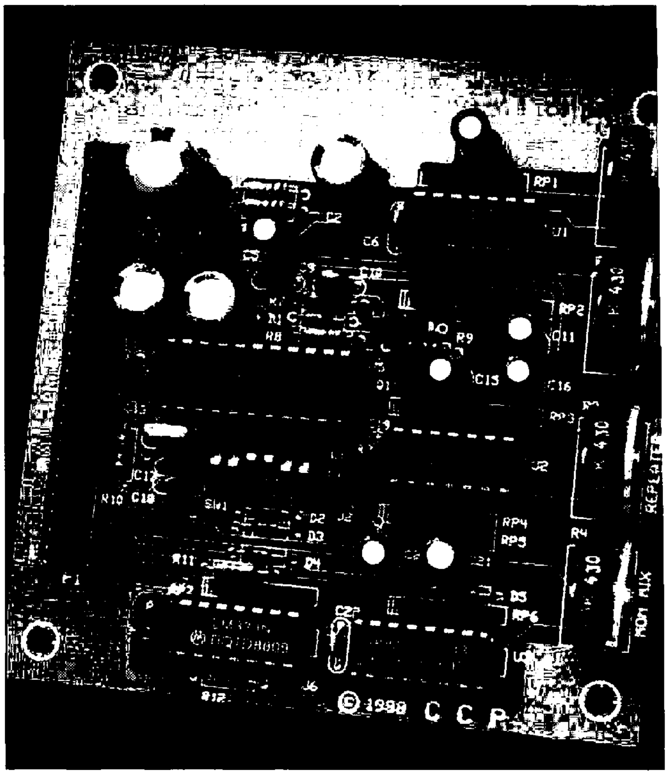
The UAI-20 is for interfacing your repeater receiver, transmitter, and link radio to any standalone repeater controller. Assembled and tested, with manual, the introductory price is $89 plus shipping. *Creative Control Products, 3185 Bunting Avenue, Grand Junction CO 81504. (303) 434-9405.* Circle Reader Service number 205.

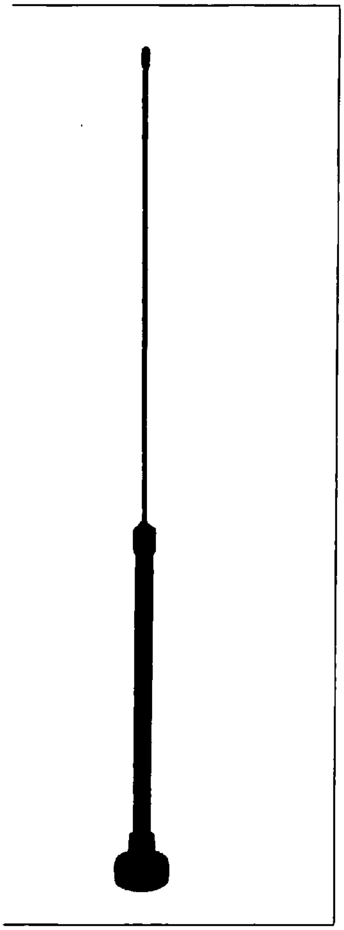


CP INTERFACES

CP Interfaces is producing a very small packet modem measuring 1⅝"x2¾" for the Digicom>64 program. This single-chip, plug-in card uses Texas Instruments' TCM3015JL integrated circuit and a few passive components. Five volts from the cassette port of the Commodore 64/128 run this modem, which consumes about 40 mA. It is small enough to allow other peripheral equipment to remain plugged in during operation.

This new modem permits 1200 baud packet operation on VHF, UHF, and 10 meters with the Digicom>64 software (which emulates the functions of a TNC). Kits are available for $38.50. Assembled and tested boards are $48.50. Shipping and handling costs are $2.50. Contact *CP Interfaces, 922 Baltimore Drive, Orlando FL 32810-5531. 407-629-2965.* Circle Reader Service number 202.





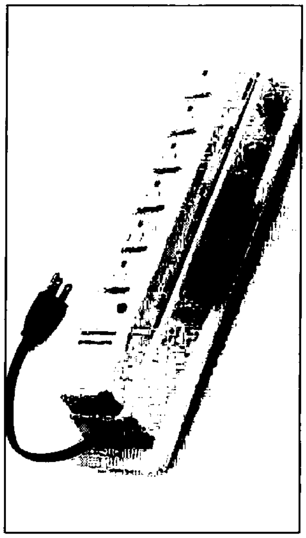
VALOR ENTERPRISES, INC.

Valor Enterprises's PA270 model two plus two dual-band antenna covers it all, from horizon to horizon. This antenna is pretuned, quarter-wave on 2 meters (144–148 MHz VHF) and half-wave on UHF (440–450 MHz). The unit includes silver-plated, spring-loaded contact. It will work on scanner radio UHF/VHF bands. Suggested retail, $49.90. *Valor Enterprises, Inc., 185 West Hamilton Street, West Milton OH 45383. (513) 698–4194. Watts: (800) 543–2197. FAX: (513) 698–7273. Telex: 724–389. Attn: Valor.* Circle Reader Service number 206.

ELECTRONIC SPECIALISTS, INC.

Electronic Specialists is introducing their SATT PRO in-home Satellite Protection System. SATT PRO provides six filter/suppressor protected AC sockets for receiver, VCR, decoder, TVRO control unit, and cable or antenna control box. Spike/Surge protection is provided for eight control and sensor lines to the dish (a 14-line option is available). Signal line Filter Suppressor options include one or two TVRO and 1 or 2 TV VHF/UHF antenna or cable lines.

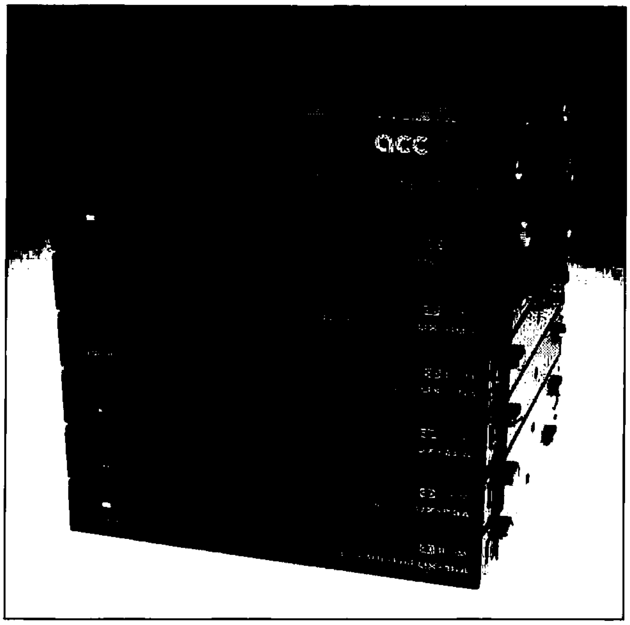
SATT PRO II-36 offers six AC socket protection, eight-line control cable protection, TVRO cable (F connector), and TV VHF/UHF cable (F connector) protection. From stock, SATT PRO II-36 lists for $240. *Electronic Specialists, Inc., 171 South Main Street, Natick MA 01760. 800–225–4876.* Circle Reader Service number 203.



HAMTRONICS, INC.

Hamtronics, Inc., announces the COR-4 COR/CWID Module, their new, low-power combination unit. It combines all the features of their CWID module COR-3 modules, including courtesy beep, in one 3x7-inch module. This new unit uses CMOS logic and an EPROM for programming, to save assembly time and allow for longer messages. It is ideal for solar/battery powered repeaters, since it draws only 25 mA on idle. Introductory price is $99 for a kit or $159 wired and tested.

Also from Hamtronics is the TD-3 Subaudible Tone Decoder/Encoder Module, 1⅜"x2 3/16", which can be used with any subaudible tone on Hamtronics, and other, receivers. It has features normally used for repeater service, such as remote on/off capability when used with the TD2 Touch-tone Module. Price, $24 kit, $69 wired and tested. *Hamtronics, Inc., 65-F Moul Road, Hilton NY 14468-9535. (716) 392–9430.* Circle Reader Service number 204.

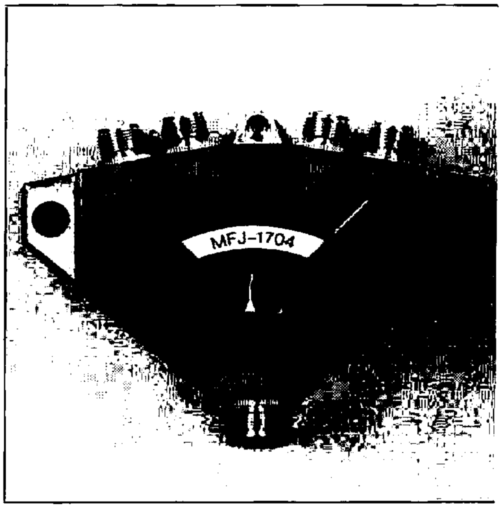


ADVANCED COMPUTER CONTROLS, INC.

Advanced Computer Controls announces their new FC-900 Interface, which is supported by several ACC repeater controllers. It permits use of the ICOM IC-900 transceiver band units as remote base and link transceivers. The ICOM fiber optic controller and interfaces aren't needed, just the band units. Hookup is simple; everything just plugs together. The FC-900 supports six bands from 29 MHz to 1300 MHz. It has full remote frequency control through Touch-Tone commands. Remote bases and links allow the repeater system designer to extend the range of the repeater and benefit from the elevation of the repeater site for all bands.

The price for the FC-900 Interface is $225. An optional programmable CTCSS encoder is $25. *Advanced Computer Controls, Inc., 2356 Walsh Avenue, Santa Clara CA 95051. (408) 727-3330.*

MFJ ENTERPRISES INC.



The MFJ 1704 4-position, 50-ohm coax antenna switch with lightening protection (replaceable cartridge) handles 2.5 kW PEP, 1 kW CW with low SWR. Isolation is rated from better than 60 dB at 30 MHz to better than 50 dB at 500 MHz. Insertion loss is negligible.

Other features of the MFJ 1704 coax switch are cavity construction, metal strip leads, outside heavy steel cavity case, and mounting holes. Unused positions are automatically grounded, or you can select the convenient center ground position.

Price, $59.95. *MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762. (601) 323–5869. FAX: (601) 323–6551. Telex: 53-4590 MFJ STKV. (800) 647–1800.* Circle Reader Service number 207.

Number 29 on your Feedback card

LOOKING WEST

Issues in Ham Radio

Bill Pasternak WA6ITF
28197 Robin Ave.
Saugus CA 91350

[This month's guest writer is Burt Hicks WB6MQV, the Editor/Publisher of *Westlink Report*
. . . de WA6ITF]

Thoughtful Policy

The FCC sanctioned the League's approach to frequency coordination, but so far it has failed to come up with a solution for multiple coordinators. In a letter dated November 28 from Private Radio Bureau Chief Ralph Haller to the ARRL's legal counsel, Christopher Imlay N3AKD, the Commission applauded the ARRL for providing a forum in its Repeater Coordination Newsletter for an exchange of ideas on the subject, for its listing of coordinators, and for its offer to arrange binding arbitration to settle coordinator disputes.

However, a copy of the letter, mailed to *Westlink Report* in an unmarked envelope, demonstrated Haller's lack of understanding of the causes of disputes such as the one in southern California. Haller referred to the infamous Kowalski letter which "created the impression that multiple coordinators for a given frequency band in a given geographical area was a possibility."

Imlay had requested the FCC to support the ARRL's interpretation of the Order in Docket 85-22 which stated that only a single coordinator could exist in a certain band and area jurisdiction, and that where there is divided allegiance, "there can be no coordinator." While agreeing with the ARRL that "there is, in effect, no coordinator," Haller chose not to expand on the interpretation of Section 97.3 (aa). This Section defines what coordinators are, but it does not provide a means for selecting them or limiting them to one in a given domain.

Perhaps the most interesting admission in the letter is Haller's tacit acceptance of Kowalski's error: "Although we did not anticipate that any amateur community would choose multiple coordinators with overlapping responsibilities in a given geographical area, it was apparent from material submitted to us by the two organizations that such had occurred. We concluded that it was not within our province to disturb the choice of the amateur community that the coordinators serve."

A Failure of Understanding

Ralph Haller evidently still fails to understand the implications of having no fixed policy in selecting coordinators. In Southern California, the long-established coordinators (SCRRBA, TASMA, and 220-SMA) were leaders nationwide in the effort to minimize co-channel and adjacent channel interference. When the spectrum began to fill up nearly a decade ago in this area (not "as the bands become saturated," as written by Haller in his letter), these coordinators found ways to make antenna patterns more directional to reduce the conflict of competing repeater stations, coordinate PL tones for a tolerable level of co-channel QRM, and finally say, "Wait, there's no room at the moment."

Experimenters and other repeater builders then went looking elsewhere (higher) for available space. This led to an abundance of systems already established on 1.2 GHz. But here in sunny Southern California, the bands are full. Yet here, some have organized a few other slothful would-be repeater operators into "selecting" a coordinator, one who charges no dues and has no meetings, bylaws, or constitution, and challenge the control of the established organization.

No Justice for the Majority

Ralph Haller says in his letter that with "some 12,000 repeaters in operation in the United States, there is but a single dispute as to the rightful coordinator." But that dispute is in an area inhabited by just about 10% of the licensed hams in the country, where mountaintop relay sites extend the coverage of these machines many times that of the average repeater nationwide. Fortunately, a settlement has probably been reached between the two organizations after the filing of a $5 million lawsuit—an amount which is a good percentage of the FCC's entire annual budget ■

. . . de WB6MQV

Number 30 on your Feedback card

CIRCUITS

Great Ideas From Our Readers

Have a quick'n'easy circuit idea? Share it and get a one-year subscription or extension to *73*! Clearly mark all entries as submissions for Circuits to distinguish them from manuscripts. Send your entries to Circuits, *73 Magazine*, Peterborough, NH 03458.

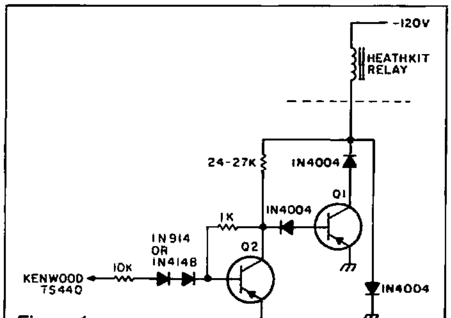


Figure 1

RELAY INTERFACE SOLUTION

Recently, someone asked me how to key the relay of a Heathkit low-band linear from a Kenwood TS-440. The relay power in the linear is obtained from the −120 volt bias supply, and the transmit keying output from the Kenwood is +12 volt at 10 mA maximum. I tried several relay interface solutions with varying results. The attached circuit solved the problem.

The key ingredient in the circuit is the PNP driver transistor which must be capable of handling at least 150 volts at about 250 mA. Several ECG types meet the requirements of the circuit. Parts are Q1: ECG 32, 160V, TO-92; ECG 39, 300V, TO-202N; ECG 240, 300V, TO-92; ECG 288, 300V, TO-92; ECG 296, 300V, TO-202; ECG 374, 180V, TO-126; ECG 397, 350V, TO-39; ECG 398, 200V, TO-220. Q2: 2N4403 or equivalent. See Fig. 1.

Hugh Wells W6WTU
Manhattan Beach CA

EASY MIKE FOR THE IC-2AT

I'm so pleased with my IC-2AT HT, I wanted an external speaker for it so I could listen while riding along, without having to hold it in my hand. I bought a commercial unit, but I couldn't find a good place to mount it where it was handy and audible at the same time. Next, I thought about getting a simple external microphone.

It took me less time to come up with a workable circuit for an electret microphone than it did to find something to put it in. After digging around, I came up with a 35mm film canister and pressed it into service.

The circuit itself is merely an off-the-shelf electret mike circuit, not unlike the one contained in the 2AT itself. Using Radio Shack components, it cost about $2 to build. Parts include one PC mount electret microphone element (RS #270-090); one 27kΩ resistor, 1 sub-mini (2.5 mm) phone plug, 1 miniature momentary contact (normally open) switch (RS #275-1547), a shielded microphone cable cut to a suitable length to suit,; and one 35mm film canister. See Figure 3.

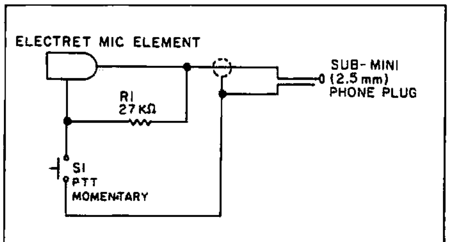


Figure 3

I drilled a hole in the bottom of the film canister for the shielded cable, and two through the cap for the PTT switch and the electret element. I used silicon caulk to hold the element in place behind the hole, allowing it to dry before I put the cap back on. I didn't use any foam over the hole to avoid "breath popping," but this has not been a problem.

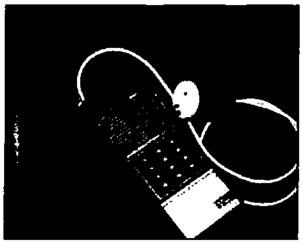


Photo A. A simple project, this external microphone adds mobile convenience to the ICOM IC-2AT.

I have been pleased with the operation of this "cheapie" mike, and find that it is a real convenience in mobile and portable operation. You can clip your HT to your belt, rather than carry it in your hand.

John R. Somers KC3YB
Crisfield MD 21817

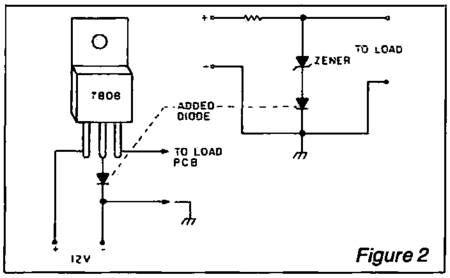


Figure 2

INCREASE VOLTAGE

The project I was making had a Sonalert-type buzzer whose operating voltage range was 7 volts to 12 volts DC. My PCB was set up for operation at 8 volts, so I put in a 7808 regulator. When I turned on the power, however, the 7808 only put out 7.5 volts. I felt I needed a better margin for the buzzer than 0.5 volts, so I added a rectifier diode and came up with 8.1 volts. This should work as well for Zener regulators. [You can "stack" (i.e., add in series to the original diodes) diodes to further increase output.—Ed.] See Figure 2.

G.R. Beckham W7FVM
St. George, UT

MOD FOR THE KWM-2

This modification changes the AGC to a hang-type and uses very few parts. It retains the fast attack characteristic. The signal causes the meter to hang. It returns to full gain quickly, about one and a half seconds after the signal is gone. The time constant of the hang-time allows the AGC to follow slow variations (QSB) in signal level. After this modification, you need to repeak T5.

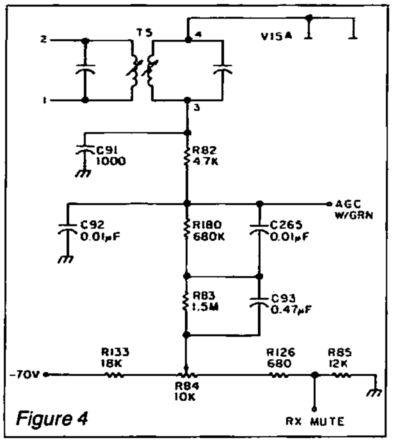


Figure 4

Figure 4 is the circuit to which you attach the modification. That section is shown again in the screened area in Figure 5, without the callouts. The unscreened section in Figure 5 is the modification.

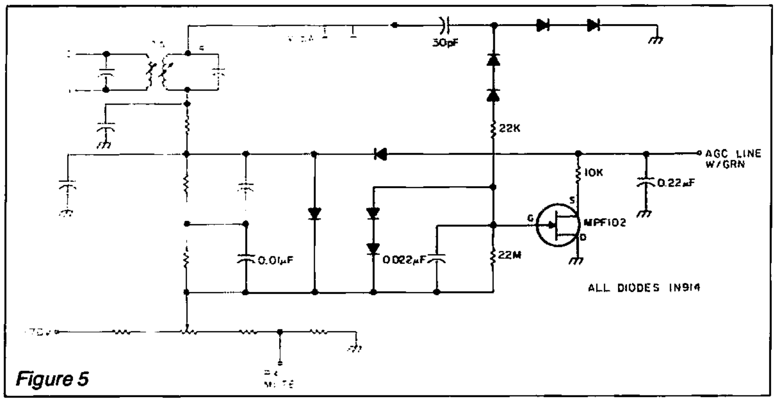


Figure 5

I also used this circuit in a Collins 75A2. The S-line receivers use the same dual time constant AGC as the KWM-2. I'm sure this modification would work with the S-line receivers, too.

Warren Walker
AC0R
Pueblo CO 81005

Number 31 on your Feedback card

QRP

Low Power Operation

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Running on "Full Power"

How many "Hello, good-bye" QSOs have you had? Why? Poor band conditions? Crowded bands? It's hard to face up to the fact that some extra punch would really come in handy. Now, before the hate mail starts, let's get real and say, "Hello there, Earth calling." At times I have had to run a full QRP gallon—50 Watts. In emergency communications, sometimes a peanut whistle signal will just not be heard. Two Watts can really get eaten up fast on a crowded band.

With a single high-gain transistor as the active device, one should be able to build amplifiers in one's sleep. Unfortunately, that is not the case. Getting a solid state amplifier to work properly is not an easy task without some basic knowledge.

Some years ago, Doug DeMaw W1FB designed a small amplifier for the HW-7. It was called "Slippers for the HW-7." The amplifier used a Motorola MRF 499A. The original article was in the December 1975 issue of *QST*. The circuit is also in solid-state design. This stud-mounted device will produce up to 30 Watts of RF. The circuit that Doug designed produced 15 Watts with 1 Watt of drive. I built the amplifier, and it worked—sort of. Using my HW-8 as a source of drive, I was able to get over 30 Watts output into a dummy load. Later, when I removed the drive, I discovered I still had over 30 Watts output! Wow! This thing was not only an amplifier, but an oscillator, too.

I thought about keying the VCC line and using it as an all-band transmitter. Transmitting from DC to light all at the same time. How did I know the output ran from DC to light? Reports of interference to a neighbor's toaster, that's how! I worked and worked to stabilize the amplifier and achieved some success, but it never did generate the 15 Watts it should have. In a letter to Doug Stivison NR1A, I mentioned this problem. Doug also had trouble with stability and getting the 499A to generate the rated power.

Power with Stability

Working with Doug, and using his suggestions, I was able to get the rated power from the 499A, with good stability. Here is what Doug and I have learned firsthand. Put these tips to use, and you, too, will be assured of success. You don't have to have an amplifier with a 499A. These tips apply for all solid-state amplifiers, no matter what kind of transistor is used. From Doug Stivison, the following:

Impedance of the output network varies with both frequency and power level, and this directly determines the power output. That is, the impedance of a 5 µH coil might be both the correct value for 40 meters at the 8 Watt power level, and 30 meters at the 15 Watt level. Conversely, this means that what you think is the right value for 40 meters at the ideal power level is actually out in left field at the actual power level.

> **"At times I have had to run a full QRP gallon—50 Watts"**

The actual power level is determined by the combination of all the output components, as well as the input drive level. Don't forget about all the spurs that are contained within the drive. A major unknown is the internal capacitance of the transistor. Most professional engineers concede that output networks are a "best guess." Even with a computerized design program and a lab full of test gear, they expect to do a lot of seat-of-the-pants diddling.

Doug W1FB did not give the length for L1; he just gave the number of turns. The inductance varies significantly, depending on how the turns are spaced. Eventually, I found that spacing the turns about two wire-diameters between turns made a big difference.

A Properly Resonating Circuit

C1/C2 seems to be critical to getting the whole thing working well. If the variable does not show a good, clean peak, you're not working with a properly resonating circuit. I also learned that C1/C2 do not work alone; there is a dramatic level of interaction between L1 and C1/C2. As best as I can tell, L2 is far less critical.

Doug's first attempts on 40 meters were just as lackluster as mine. All seemed fine and dandy until the antenna was connected. The SWR went 12:1. This is a classic situation we have all seen. Using a grid-dipper as a wavemeter, I found RF on 4, 6, 7, and 14 MHz. God only knows what was going on in the MF and LF ranges.

Essential Troubleshooting Equipment

It would really be grand to have a room full of test equipment for troubleshooting, but most of us don't have this. Yet, to dig out the critters, there are a few things that should be in everyone's shack. First, you'll need a good amp meter. By placing it in line, you can get a good idea of what the PA transistor is doing. Before you apply drive, connect the amplifier to the power supply.

For a Class "C" amplifier, you should see no collector current flowing. If upon firing up the power supply, you see large amounts of collector current, quickly turn it off! You've got some bad trouble. An amplifier that should produce 12 Watts output should also consume about twice that amount in collector current. In other words, a current draw of about 2 amps at 12.5 volts should produce about 12 to 15 Watts output, depending on the efficiency of the transistor. If you notice current of 5 amps, with 8 Watts output, the transistor is running away, producing all kinds of crud all over the place. After you remove the drive, current should fall to zero again. If it doesn't, you'll have to get out the second tool of the trade.

I use a small transistor radio tuned to the low end of the broadcast band. If the amplifier is producing LF and MF spurs, you'll be able to hear it in the radio. Remember to terminate the amplifier into a good 50Ω load.

Let's say that you notice nothing on the radio, but when connecting the amplifier to a tuned antenna, the SWR is way out of line. This tells you that the amplifier has critters on the output other than the required frequency. In most cases, you'll have to get your hands on a grid-dip meter or wavemeter. You can then find out what frequencies are being generated along with the fundamental one. A frequency counter can also be pressed into use here. By placing a one- or two-turn pickup loop by the amplifier, the counter will lock on and display the frequency that it sniffs out. If the counter "rolls" then there is so much crud the counter can't get a lock on it. This is a good test. So, with just a handful of common test gear, you should be able to de-bug most amplifiers.

Stabilizing a Solid-State Amplifier

How do you get a solid-state amplifier stable? That's a hard one. Here are some more tips that I have found to be helpful.

Keep the output away from the input. This is sometimes easier said than done. Use shielded cable. Place the amplifier inside an RF-tight enclosure. Bypass the VCC line going to the amplifier. Sometimes a shield of double-sided PC board placed across the top of the transistor will provide shielding between the base and collector.

Terminate the amplifier into the proper load. Don't expect good results with a so-so antenna. The antenna should provide a good load to the amplifier. Use a proper sized heat sink on the PA to keep the transistor from failing due to thermal runaway. Don't stress the mounting stud on transistors that have them. Amplifiers that are built on double-sided PC board should have both sides of the copper foil connected together in several places, the more the better.

Although I'm not an RF engineer, I've played with solid-state amplifiers enough to know you'll pull your hair out working with them. But that's half the fun, isn't it?

Doug DeMaw did a fine job on the "Slippers for the HW-7." The outcome depends on how well the amplifier was constructed. Hopefully, you won't have trouble when you build a solid-state amplifier for your QRP radios, but if trouble does raise its head, you can fall back on these tips. If you can't fix it, at least you're headed in the right direction.

Next month we'll look at some home-brew tips for your spring projects. Keep the cards and letters coming. I use them to guide the column. As always, this is your column, for the QRP operator.

Number 39 on your Feedback card

HAM HELP

Your Bulletin Board

We would like to get in touch with operators of HF rigs on boats to discuss operating problems specific to a marine environment such as mounting HF antennas on the boat, effective power regulators, shielding, etc. Specifically, we are looking for other sailor amateur radio operators in the New England region. Thanks!

Jim Charboneau KC1BB
28 Constitution Rd.
Charlestown MA 02129
(617) 242-7326

Do you have any "hidden secrets" of the PRO-2021? If you do, please contact me.

David Lansing
2 Yost St.
Johnstown NY 12095

Wanted: information and copy or photocopy of manual for a Lafayette HE 50A 10 meter transceiver. Will pay cost.

Al Wilde W8JZZ
552 T-L
Du Bois PA 15801

Needed: Vibrosender, model or type number TU217, preferably 110.9 MHz.

Joe Jatis W9CYT
1515 Sommerset Ln.
Schaumburg IL 60193

I am looking for circuit diagrams, and/or operating manuals for the following (postage and copying costs gladly refunded): Akai or Mitsubishi Model VT 100 Portable video equipment (hope to use for ATV); IMC Deluxe Model GM1211 monochrome video monitor; RCA triatic capacitor tester (no model as shown).

Ladd Sajor W2KGV
767 Lomas St.
Port St. Lucie FL 24952

I would like information on any modifications to the Atlas 210X.

Scott Liedling KS5N
7622 Evergreen Brook Way
Houston TX 77095-4026

Need info on converting late-model 440 MHz transceivers to 460–470 MHz for college class project. Any info appreciated. Will pay copy and mailing costs.

R. Bellville
P.O. Box 515
Millbury MA 01527

I am interested in receiving amateur-related video tapes of large antenna arrays, unusual equipment or events, or anything out of the ordinary for rebroadcast via Fast Scan Television in the Cincinnati area. I will pay all costs involved. I can use either Beta or VHS format.

Ron Rollinson NR8O
128 Julep Lane
Cincinnati OH 45218

I need a schematic for the Swan 350B and schematic/manual for the Swan HF 700S transceiver. Will pay any charges. Thanks.

Charlie Wallace
Rt. 3, Box 223K
Big Pine Key FL 33043

Wanted: Machine language program for the TRS-80 Model I, Level 1 or 2 (prefer level 1) to TX/RX RTTY via expansion port. Will pay nominal fee.

Frank Brinson
5113 Richland Ave.
Chillicothe IL 61523

I need a service manual or at least a schematic for an Edgecom System 3000A VHF FM 2 meter transceiver. I will pay for copying or other costs.

Chuck Crowley K5BER
215 Clower Ave.
Long Beach MS 39560

Gentlemen: I just "inherited" an *old* Gonset Communicator II, 2 meter AM transceiver! Someone removed the mike jack and didn't sketch the location of the wires. I need a schematic for this unit. If you have one, I'd be glad to pay for copying and mailing costs. Thanks for helping me get this old rig back on the air!

Bert Voth WAØPWE
802 Forest Drive
Olathe KS 66061

I need a diagram and part values for my ailing Hickock Teaching Aids Scope, Model OSK-4, and will be glad to reimburse someone for copying costs and postage.

Paul Hinkamp W8YOU
1304 Ashly Ct.
Midland MI 48640

Continued from p. 5
projects for *73*, I'll put out booklets of them.

Suggestions for Construction Projects

What can we build? Lordy! We haven't even scratched the surface with 10.5 GHz equipment. We need QRP gear for 10 meters to use with the new sun spots. We need conversions of CB to 10 meters. We need small receivers and antennas for hidden transmitter hunting. We need all sorts of simple test equipment—dippers, field strength meters, capacitor and resistor decades, Q-meters, etc.

Is anyone building outboard accessories for our commercial ham gear? How about inventing an automatic call identifier for HF rigs? How about hooking up some ICs and developing some really narrow-band communications systems?

We need lots more beacon stations on 6 meters and up so we can hear when our bands open. These beacons need automatic keying systems. Perhaps we could work up some beacon digipeaters so we could send coded pulses out periodically and listen for beacons that we've triggered to tell us where the band opening is. There's plenty to do if you'll take the time.

Our 1250 MHz band is almost unused, so how about some simple rigs and receivers for it? If our amateur TV fanatics had used 1250 instead of fighting over a single lousy channel on 430 MHz, we might have been able to keep from losing 30% of the band.

How long will the FCC hold 900 MHz for us if we keep ignoring it? It isn't like it's difficult to make rigs for this band, you know. Of course, if you feel it's more important to watch the ball games and sitcoms and rent movies, then I question your priorities. Are you throwing away time every single morning watching the *Today* show? You can keep up with the news in just five minutes. The rest of the show may be entertaining, but it isn't of much informational value.

The evening news on TV? Another five minutes will let you know what's top and the rest you can catch up on in a few days with *Newsweek*. If it's of any importance it'll be in *Newsweek*. If it isn't, the chances are you've wasted your time. Newspapers? You're joking.

Let's get those soldering pencils sharpened and start getting stuff working you can get into *73*. UHF, QRP, RTTY, I don't care . . . just DO it!

There, I haven't said a word about no-code. Doesn't that make you happy?

Ham Suers

It is difficult not to think of an amateur who stoops so low as to sue another amateur or group in less than the worst terms we can apply to a human being—but I'm trying. This is supposed to be a hobby. It's supposed to be for fun, and that has no connection with suing.

My first reaction is to ask the FCC to enact a new regulation that says that anyone who brings a lawsuit against an amateur or an amateur group involving amateur radio, have his license revoked forever. Actually, while I'm not generally a fan of capital punishment, I might go for the death penalty for ham suers. And none of this stuff like the electric chair or the gas chamber; let's get back to public hanging or perhaps something with boiling oil.

In amateur radio we have a hobby that of necessity has to be regulated to some extent by the government, since we're using several billion dollars worth of publicly-owned frequencies for our entertainment, with just enough public service thrown in (my estimate: 0.001%) to barely keep commercial interests at bay.

The FCC is happiest when they hear nothing from us. They really don't want to be bothered with rule changes or with our interfraternity squabbles. They don't want to monitor and regulate us, so if we cause them trouble and/or expense, it's likely they'll take the obvious path: get rid of us. They have enough to do with the commercial services and they don't need to waste time on us freebies.

When you get your ham license, you get the authority to start using our ham bands. In general we agree among ourselves how we'll cut 'em up, and the FCC goes along with our decisions. They'd like it much more if we could manage ourselves 100% and leave them out of it.

Self-Regulation

Indeed, I've proposed that we organize a national conference every other year with the specific purpose of updating our regulations. I suggested that interested ham clubs field two representatives for the conference. It would be molded after the International Telecommunications Union Conference in Geneva.

The first order of business would be for member clubs, those fielding conference teams, to submit their proposed rule changes well before the conference. These proposed changes would be discussed by the clubs and their delegates instructed as to the wishes of the group. These would be circulated to the other clubs for further consideration.

At the conference, each rule change would be remanded to an ad-hoc committee to consider it and come up with a compromise recommendation to present to the conference as a whole (the plenipotentiary) for a vote. The results of the conference would be enacted immediately by the FCC.

I've discussed this with several FCC commissioners and found them all to be enthusiastic about this approach. I've been assured that the Commission would find it in their budget to provide the conference with FCC legal advice so our proposed rule changes would not run into legal hurdles.

Such a system would make it possible for us to have regulations that meet our immediate needs. With the present system, it often takes years before a rule is changed, and even then, in almost every case, the rule is no longer needed.

Such a system might encourage us to develop more gentlemen's agreements in place of cut-in-stone rules. I've never been disappointed at the results of such amateur radio cooperative efforts in the past. Indeed, I've always found them to be almost excessively protective of even the smallest ham interests.

We should understand that our license does not guarantee us anything. It is a license to use the ham bands, but it does not guarantee us a clear frequency or a solid contact. It does not even guarantee a QSL.

Ham Protectors

Now, getting back to the suers in our midst, perhaps it's time for a new national ham organization to get set up primarily to protect amateurs and amateur groups against misguided hams who have the insane notion that their license has guaranteed them the use of a frequency—a repeater, clear channel, or whatever. I have no problem dealing with people who are rational, but when people are no longer rational, I get as frustrated and angry as anyone else.

If we set up a national amateur radio protective association, we could get ham clubs and groups to join it to give us the national strength we'd need to keep lawsuits from happening. I'll bet we could get some savvy ham lawyers to work with the association to bring counter-suits for harassment, for harm to the general ham good, etc., in the federal courts. The spectre of such an expensive federal counter-suit might put a chill on this suing baloney. We're a national hobby, governed by the federal government, so it only makes sense to mount any counterattack in a federal court, complete with the protection of PRB-4.

No, I don't need the aggravation of running a new national ham association. And the ARRL certainly isn't going to set anything like this up. But is that all we have, me and the League? Give me a break! If that's the only action we have in the whole danged hobby, then it's time to give every suer what he wants.

Buying Justice

Instead of setting dues for club membership in the national de-suer organization, I'd suggest a plan whereby clubs would join and agree to share in the legal costs required to keep litigation at a minimum. If the costs are so high they seem unreasonable, the clubs will drop out. But if we can get 500 ham clubs to join such an association, we'll be able to outspend even the most vicious suer—and that's how you win justice in America. It's got little to do with laws, little to do with what's right, and just about everything to do with who has the money. If you have the idea that I do not respect our legal system, you're right. It is not something of which America can be proud.

Twenty-five years ago I formed the Institute of Amateur Radio. I started it as a way to organize group ham travel. Once started, I found a lot of support for it as a source of funds to help amateurs fighting legal suits, such as tower suits, which could hurt amateur radio. We had a good deal of success with that goal, winning some big ones.

But a combination of a divorce that knocked me for a loop, an inability of the board of directors to find someone else to run the Institute, and endless attacks by the League (that spent far more fighting the IOAR than ever, taken in Institute membership dues), finally did it in.

By the time I'd gotten over my divorce, amateur radio was in a shambles as a result of the ARRL's Incentive Licensing proposal, so the Institute has remained history.

I've been gathering the names and calls of the hams who have instituted lawsuits against hams or ham groups. I'd like to list them in the magazine so you'll all know who these people are. I'll be interested in hearing from anyone who actually has a legitimate suit going. That might change my mind about such hams being cancers on the body of amateur radio.

May I repeat that a ham license is a permit to operate. It does not guarantee anything. Yes, every amateur has the permit to set up a repeater, but since this is a hobby and we have very limited frequency resources, it's up to us as a group to come to agreement on who sets up on what frequencies. And if we can't, then it's just tough.

Until the time I get into an area and don't find at least one repeater unused, with no one answering my calls, I'm not going to be convinced that we have any shortage of repeaters. In my experience—and I travel a lot—about 90% of our repeaters are terribly underused. I view the desire to set up more repeaters as an expression of ham egos out of control and not representative of any public need.

So, are our ham suers dirty, rotten scum, or do they have a legitimate case for helping keep more lawyers living in luxury?

SETI, UFOs and Amateur Radio

SETI, the search for extra-terrestrial intelligence, and the tens of thousands of UFO reports we've had, would seem to make it worthwhile for some of us to look for signs of alien communications. I say, if we can't find intelligence here on earth, let's look for it elsewhere.

But before we waste a bunch of time looking for signs of alien communications, just how probable is it that there are other civilizations out there? And if they're out there, how come we haven't seen or heard 'em yet? It's difficult to work up a computer simulation of the problem because there are so many unknowns. Are we wasting our time looking for something that may not be there?

Many scientists agree that the universe is about 15 billion years old. Fine, except that we've run into some meteors that appear to be about ten times that old. Hmmm. Oh well, just an anomaly, never mind.

And was there a big bang or not? Opinions are increasingly mixed on this, with some scientists opting for multiple big bangs, each forming its own universe and eventually separating from the others. Read *Sky and Telescope* magazine to keep up with the most recent cosmology developments. The field is in an uproar.

There's convincing evidence that life is being spread throughout the universe by an even older intelligence, and that these seeds have been resulting in the sudden springing up of various basic species of life. The seeds seem to be of a wide variety, with those adaptable to the conditions on a given planet taking hold. This line of reasoning and the data that support it may be troublesome to many religious people, who much prefer the comfort of two- and three-thousand year-old explanations over those of modern science, even keeping in mind how rapidly science has had to change its theories to keep up with developing data. *Discover* magazine has had some interesting articles on this.

But let's ignore for a moment that our universe may be of relatively recent development. We have pretty good data showing it to be about 15 billion years old. Yes, there are some problems with this. The estimated age is dependent upon the red shift of distant stars and galaxies. Now we're finding stars that seem to have vastly different ages within the same galaxies, and that's screwing everything up.

If we figure that the first stars in our galaxy started about 10 billion years ago, and we know our sun is about 5 billion years old, it's logical to expect that the first civilizations got started even before our solar system was formed. If it took us five billion years to go from a starting solar system to porno shops and repeater jamming, that's a good yardstick to apply to other solar systems, right?

It turns out that no matter how discouraging a scenario you hypothesize, with most civilizations either nuking themselves, running out of resources, or having no spirit of adventure, the universe would still have been fully occupied billions of years before our solar system even got started. See the November '88 issue of *Analog's* science fact article.

Where Is Everybody?

The computer simulations come up with millions of civilizations, organized into about 50 major cooperative

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groups. So, if the entire galaxy is already civilized, where IS everyone? And how come we don't hear 'em on the radio?

Radio is pretty hot stuff for communications, but I hope we're not so arrogant to think that just because we haven't yet discovered it, there's no better communications system possible. The probability that there are civilizations all through our galaxy, and that they are communicating, is enough to suggest that we have some inventing to do.

It's odd how scientists have always tended to think that all the basics have now been discovered. If you read much, you know that there was a move to close the Patent Office about 90 years ago because everything had been discovered.

Just look at how radio astronomy has grown in the last 50 years. Did you know that this science was developed by a ham who was curious about some anomalies? Scientists hate anomalies. They tend to dismiss them—must be bad data or something. Don't bother me. This has been a major deterrent to mind research and has a lot to do with the still primitive development of psychiatry.

Not Fit Company—Yet

If there are so many civilizations all around us, how come they're not here? Well, we don't know they're not. It's also likely that they know we're here, and they're letting us develop on our own until we're ready to join their galactic civilization. I hope you'll agree that we're not yet fit company for any intelligent group. It still isn't even at all clear that we're going to survive. Between our potential for nuclear self-destruction, and the destruction of our environment, it's iffy.

If you've read Tom Clancy's books, you'll have a better concept of how iffy things really are. His *Red Storm Rising* is a rouser about WW III, and not all that far-fetched.

Terrorism seems to be gaining ground as a minorities' weapon. How long will it be before a group finally gets their hands on a nuke? Whammo will go New York, Paris, or Moscow. Then what? Yes, I know, we'll have dozens of weary old hams trying to provide communications with Morse Code—trying to send the millions of desperately needed messages.

Getting back to communications. Since it's virtually certain that there are a zillion civilizations in our galaxy; and since we know they must have darned good communications to run something like that; and since we're not hearing 'em on the radio—ergo, they've got something better. A lot better. Maybe even faster than light speed. Some time in the next one or two hundred years, someone is going to discover this new system. And when they do, people will say, hey, we should have found that years ago. We had the hints and we ignored them.

It's in the Anomalies

I ran an article in *73* a few years ago about how some hams came across the semiconductor phenomenon and ignored it as an anomaly. They could have beaten Bell Labs to the transistor by years if they'd not been close-minded about it. I wonder if there might be some hams today who have come across something odd and ignored it.

It's getting time for us to do something new. In the past, amateur radio was always way ahead of commercial radio. We did the inventing and pioneering then, after we'd proven to the professionals, against their wills, that what we had worked. They reluctantly climbed aboard. Today, alas, we're ages behind the industry. Instead of being out front leading, we're at the tail end with our blinders on.

Many amateurs are eager to sacrifice our whole hobby to preserve 400-baud Morse Code in a day when 56,000-baud automated communications will soon be a standard for commercial communications. We're like a mob, blinded by our emotions to the realities of the 80s. When someone says "no code," a lynch mob quickly forms to hang the SOB. Just look at my neck, if you think I'm exaggerating.

The 40% zap of 220 MHz may help to bring some of the angry lynch mob to their senses. It's a cold cruel world and we're going to lose amateur radio if we don't start paying for the use of our billions of dollars worth of frequencies—over 99% totally unused, and the rest being used almost 100% for the entertainment of a small group of rapidly aging, old men.

At any rate, we know there is a far better communications system than radio. It's there, if we can discover it. And who else is there? Government and private research lab groups would be laughed at for even proposing to spend what little research money is available for such a project. Labs have to prove that their projects are going to pay off—and quickly—if they're going to get funding. This is why virtually every major advance in science has been made by amateurs.

So let's stop shooting the messenger and see what we can do. If you have any ideas for areas that should be researched, let me hear from you. We may be a doddering group of old men, but we still have some sharp minds left in our old bodies. Let's put 'em to work.

Narrow-Band CW

Last month I explained how new digital technologies have made it possible for us to greatly reduce voice bandwidth, possibly allowing up to 7,000 more users than at present in our bands, yet with far less QRM. And that's without even resorting to regenerating the voice with a computer.

Now let's look at CW and see what technology holds for us there. With CW, we don't have to worry about maintaining the original voice tones and quality, so we're able to head for some serious bandwidth/time economies. After over 60 years of using CW, perhaps it's getting time for us to at least consider updating this mode.

Before I get into compression technologies, let's first consider the whole CW system. It starts with you sitting there (you don't stand, do you?) keying your rig. This sends a series of semi-decipherable dots and dashes over the air. Two generations ago most of us used straight hand keys. Then we shifted to bugs and semi-automatic keys. A few years back, as digital electronics and hundred-dollar computers took hold, most of us shifted to keyboards.

It wasn't very long ago that most of us had to sort out the dits and dahs by ear—a prisoner of our incompetence. Then electronics saved our hash, freeing us from the cacophony of chirps and beeps. Now almost all of us read our code on our Commodore VIC-20 or C64 computer screens. Long live CW, I say!

A few days ago I wandered the halls of the Summer Consumer Electronic Show in Chicago. I enjoy seeing what the Japanese have invented and built for us lately. I also almost enjoy meeting the hundreds of hams who come up to me and say hello—complete with their call letters and, with one hand firmly grabbing my lapel, bemoaning that ham radio is dying.

One chap did have something of interest—even promised to write about it. It seems that he's been working on a project for a large communications firm that is interested in getting our shortwave bands, so he's well-funded. His first step was to set up video recorders with wide-band receivers and tape our CW bands for a month.

This is an interesting approach to surveying our bands. I first ran into it when I helped operate the moonbounce effort at Arecibo a few years back. We were tuning the 1296 MHz band as best we could, making contacts all around the world. But, just to make sure, we also taped the whole band on video tape so it could be tuned later on to make sure that no signal coming through was missed.

> ***". . . we'd need maybe three channels to handle everything we've been using the 80 meter band for. . ."***

With a month of the CW sections of 80, 40, 20, 15 and 10 meter on video tape, the next step was to set a computer to deciphering the CW signals. Once programmed, a PC clone just sat there and worked its way up the bands, copying every contact made. Each tape had six hours recorded, so it only took four tapes for each day taped.

The complete text of every CW QSO heard during the three weeks was thus decoded and printed out. The next step was to examine the contacts—charting the number in progress in every five-minute period in each band and the code speeds used. As I recall, it came to about 4,500 words, with approximately *300 words accounting for over 95% of all communications* except for operator names and locations.

One approach to updating CW might be to digitally encode our Morse and send it in short packets. These would be received at the other end and translated back into Morse—which could then either be copied by ear or with a computer.

We don't need the whole ASCII alphabet for this since we don't send upper/lower case characters in Morse. We could get by with about a total of 50 characters—which could be represented with six bits. We'd add a start bit, a parity bit, and two stop bits, for a total of 10 bits. Better yet, we could send two characters at a time and do it with 16-bits.

Callsigns could be even further encoded for economy. Almost all calls, including a portable designation for displaced hams, could be sent with eight characters. This would take four bytes of 16 bits each—and 16 bits is the way the computer world seems to be going. If we went to 32-bit bytes, our calls would only require two.

But why spell out the 4500 words we use? If we assigned a number to each English word we could just send the numbers. A word averages five letters plus a space—six characters. If we set up a dictionary of 64,000 words we could communicate them with 16 bits—one byte. That would cut down our transmissions by a factor of six right there. If we could live with a 16,000 word dictionary, we could send two words, complete with start, parity, and two stop bits in our 32-bit bytes.

By sending our packets at high speed, for a fraction of a second, we would occupy a wide band—but the average use of each channel would be far below our present throughput.

A high percentage of our CW contacts are routine, I'm sure you'll be surprised to find out. This provides us with even further opportunities for economy of transmission. The sending of a town name could easily trigger a more complete response on the receiving end which would add "QTH HRZ" automatically. Heck, we don't want to have our digital technology actually spell all our words, do we? No, I think we should maintain our CW abbreviations, just as we do on phone. Phone ops freely use the Q-code, even though it's totally unnecessary.

The whole QSL situation can be covered with one number that would translate on the receiving end into, "QSL HR 100%, PSE SND YR QSL."

The beginning of each contact could include a code that would indicate the CW speed being sent, perhaps in increments of 2.5 wpm up to 20 wpm, and then in 10 wpm increments beyond that. We could send that code with four bits at the beginning of each QSO, taking us to 100 wpm, that should be enough for even the most discriminating ear.

But, you ask, how on earth can a hundred or more contacts all use the same channel without incredible confusion? I'm sure there are a number of ways this can be done. I think I'd opt for a time assignment system. With each transmission taking about a hundredth of a second, we could have our rigs send a short marking pulse every couple of seconds to indicate that this particular time slot is occupied. Our rigs would select an unused slot and start marking it.

By channelizing our communications as we do on the VHF bands, we'd be able to avoid interference (QRM). A CQ could be sent by just sending your call/location in a time slot until someone else answers on the alternate second, and away the contact would go.

A system like this would enable us to clear out about 99% of 80 meters. Actually, judging by the band occupancy study I mentioned, we'd need maybe three channels to handle everything we've been using the 80 meter band for, and even less on the higher bands.

To satisfy our older amateurs who are worried about what will happen if there is an emergency and our commercial power goes out, we really should make everything work on AA-sized NiCd batteries and recharge them with a few solar cells. I visited a solar cell factory the other day, and they're turning out small cells that generate 1.5 watts per cell!

If we do start trying to take advantage of technology, we could end up with almost empty ham bands that would make us either get more hams to fill them or else face their loss.

C'mon, I know there are a bunch of you who have the technical smarts to get us at least into the 80s. Let's see some action—some circuits you've tested that I can publish in *73*. ■

Number 32 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

DOVER NJ
APRIL 1

The Split Rock Amateur Radio Association, Inc., is sponsoring the North Jersey Hamfest beginning at 8 AM at the Dover Armory. VE exams, dealers, flea market, tailgating, prizes, refreshments. Admission is $3, nonham spouses and kids free. Tables, $8. Tailgating, $5. Vendor pre-registration *PO Box 610, Rockaway NJ 07866*. Talk-in: 146.385/.985rpt and 146.52. Contact *Harvey Klein WA2JHT at (201) 538-1768, evenings*.

BALTIMORE MD
APRIL 1-2

The 1989 Greater Baltimore Hamboree and Computerfest, the largest multi-interest computer, amateur radio, electronics show and indoor/outdoor flea market in the Mid-Atlantic area, will be at the State Fairgrounds in Timonium. Large exhibit areas in three buildings, free parking, door prizes, food. Admission is $5 for both days, with children under 12 free. Write *GBH&C, PO Box 95, Timonium MD 21093-0095* or call *(301) HAM-FEST 24 hours a day*.

MADISON OH
APRIL 2

The Eleventh Annual Lake County Hamfest will be held at the Madison High School from 8 AM to 3 PM. All-indoor flea market, commercial exhibits, programs, prizes, and food. Admission, $4 at door, $3 in advance. Talk-in on: 147.21/.81, 222.90/224.5. FCC exams. Tables, $5 and $6.50. Write *Roxanne, 7803 Skylineview Dr., Mentor OH 44060 (SASE please). (216) 953-9784*.

LONGMONT CO
APRIL 2

The Longmont Amateur Radio Club (LARK) is sponsoring a swapfest from 8 AM to 3 PM at the Boulder County Fairgrounds. This will be a combined Hamfest and Computer Swap. For information, contact *Bob Dornan WA2EKU, 1106 Fordham St., Longmont CO 80501. (303) 651-3613 or Ken Parker WØONF, 1221 Aspen St., Longmont CO 80501. (303) 772-4719*.

CALVERT CITY KY
APRIL 2-3

The Marshall County Amateur Radio Association will operate KM4GS in conjunction with The 146th Annual Tater Day at Benton, Kentucky, from 1700Z on the 2nd to 2359Z on the 3rd. Operation will be in the lower 25 kHz of the General portion of the 80-10 meter bands and the 10 meter Novice band. For a special "TATER DAY" QSL, send QSL and SASE to *KM4GS, PO Box 917, Calvert City KY 42029*. Special QSL to SWLs for report and SASE.

TEANECK NJ
APRIL 8

Ham radio flea market sponsored by the Chestnut Ridge Radio Club will be held at the education building of the Saddle River Reformed Church in Upper Saddle River. Table, $10 for the first, $5 for each additional table. Tailgating, $5. Admission, $1. Contact *Jack Meagher W2EHD, (201) 768-8360*.

COLUMBUS IN
APRIL 8

The Columbus Amateur Radio Club Hamfest will be at the Bartholomew County 4-H Fairgrounds from 8 AM to 2 PM. Talk-in is on 146.79 minus 600 Hz. *David Mann KA9UUP, 458 N. Country Club Road, Columbus IN 47201. (812) 342-6302*.

FRAMINGHAM MA
APRIL 9

The Framingham Amateur Radio Assn. will hold its annual spring flea market and license exams at the Framingham Civic League Building. Admission $5 for Early Bird Buyers who come before 10 AM. Admission after 10 AM is $2. Tables, $12 each, includes one free admission. Preregistration required for the flea market and exams. Talk-in on 147.75/.15 Framingham Repeater. For information, contact *Jon Weiner K1VVC, 52 Overlook Drive, Framingham MA 01701. (508) 877-7166*.

BRAINTREE MA
APRIL 9

The South Shore Amateur Radio Club of Braintree willhold its annual indoor flea market at the Viking Club from 11 AM to 4 PM. Tables, $10 each, includes one free admission if paid before April 7 to *Hal Jones WB1ABM, 48 Saning Rd., N. Weymouth MA 02191*. Tables $12 after the 7th. Checks payable to the South Shore ARC. Doors open to vendors at 9 AM with entrance fee of $1. Free parking. Questions? Call *Hal, (617) 335-5777, evenings*.

FERGUS FALLS MN
APRIL 15

The Lake Region Amateur Radio Club is sponsoring its annual Hamfest from 8 AM to 2 PM at the Otter Tail County Fairgrounds-Hockey Arena. VE testing, packet meeting, Army Mars State Meeting, satellite meeting and demo, commercial dealers, flea market, concession stand, and more. Registration, $4 at door, $3 in advance. Tables, $4. Call *(218) 826-6274* or write *Keith McKay N/0FKF, Rt. 1 Box 46, Battle Lake MN 56515*.

LAWTON OK
APRIL 15

The Lawton-Fort Sill Amateur Radio Club will hold its 41st annual Hamfest at the County Fairgrounds from 8 AM to 5 PM. No preregistration necessary except for table space. Talk-in on 147.39/.99. Contact *Claude R. Matchette, 3411 NW Atlanta Ave., Lawton OK 73505. (405) 357-5870*.

CHARLESTON WV
APRIL 15

The Tri-Counties Ham Club and the Kanawha Amateur Radio Club are sponsoring the annual WV Area Hamfest and Computer Show at the Charleston Civic Center. Admission is $5, tables are $6 each. AC power is $12. Walk-in VE exams and alternative programs. For dealer and flea market information, write *PO Box 1694, Charleston WV 25326*, or phone *Bill Hunter K8BS at (304) 744-2650 or Lovell Webb at (304) 342-7247*. For other information, write *PO Box 9076, So. Charleston WV 25309* or phone *Doug Sweeney at (304) 766-6655*.

BIRMINGHAM AL
APRIL 15

Foxhunt! Three transmitters on 2 meter FM will be hidden in Oak Mountain State Park. Trophies to the top finishers and handsome certificates for all participants who complete the hunt. Map and RDF session before the hunt. Talk-in on W4CUE/R, 146.880 MHz. Camping. Contact *James Pilman KA4ZQA, (205) 991-7762, evenings. Leave packet messages for KA4ZQA at W4CUE PBBS in Birmingham*.

HUDSON NH
APRIL 15

At 9 AM on the 15th, the I.R.S. will hold a flea market at the Lions Club Hall. The Interstate Repeater Society, a Derry, New Hampshire, based club plans a non-taxing time at their annual flea market. Admission, $2 (includes raffle ticket). Tables, $10 each. Talk-in on 146.850 and 224.460 I.R.S. repeaters. For reservations, contact *Wayne KA1MKH, (603) 895-9033 or Chan KA1OU, (603) 497-4333*.

SPOKANE WA
APRIL 15-16

The Twelfth Annual Inland Empire Radio Hamfest will be held at a carpeted, air-conditioned Convention facilty this year. It will feature an evening Banquet, an Awards Breakfast, Forums, Flea Market, Commercial Displays, prizes, seminars, swap tables, VE exams. Admission is $5 for both days. Contact *Ivan Brown KF7PU, W. 728 Spofford Ave., Spokane WA 99205. (509) 328-7961*.

TUCSON AZ
APRIL 15-16

The Old Pueblo Radio Club will operate W7GV, the oldest continuously active callsign in Arizona, from 1500Z the 15th through 2400Z the 16th to commemorate 60 years of worldwide amateur radio operation on the 10 meter band. Operation will be over the entire 10 meter band, including CW, phone, FM, and packet gateways. For a QSL, send your QSL and SASE to *W7GV, Box 42601, Tucson AZ 85733*.

CAMBRIDGE MA
APRIL 16

TAILGATE electronics, computer, and amateur radio FLEA MARKET on the 16th, from 9 AM to 4 PM. Admission, $1.50. Free off-street parking. Tailgate room for 200 sellers. Sellers $6 at the gate, $5 in advance, includes one admission, set-up at 7 AM. Talk-in on 146.52 & 449.725/444.725-p1 2A-W1XM/R. Sponsored by the MIT Radio Society and the MIT Electronics Research Society. For space reservations or further information, call *(617) 253-3776*. Mail advance reservations before April 1 to *W1GSL, PO Box 82 MIT Br., Cambridge MA 02139*.

LEBANON PA
APRIL 16

The Appalachian Amateur Repeater Group (AARG) will hold their first Hamfest and Computer Show at the Lebanon area Fairgrounds. General admission is $3; nonham spouses, YLs, and kids free. VE tests (preregistration only), tailgating ($2/space), indoor tables ($5 with electricity, $3 without), prizes, vendors, parking. Talk-in on 146.04/.64 and 146.52/.52. *ARRG, Homer Luckenbill WA3YMU, 105 Walnut Street, Pine Grove PA 17963. (717) 345-3780.*

ALCATRAZ ISLAND
APRIL 22

The Sacramento Amateur Radio Club, operating station W6AK, will operate from the bakery of the old Alcatraz Prison from 1700 to 2230 UTC. Suggested frequencies: SSB—7.270, 14.300, 21.400, 28.450; CW—7.125, 14.05, 21.085, and 28.150. Also, 2 meter FM will be on 146.52 as well as on a 2 meter packet station. QSL from "The Rock," SASE please. *SARC, PO Box 161903, Sacramento CA 95816.*

NEBRASKA CITY NE
APRIL 27-30

The Nebraska City Amateur Radio Club will operate KØTIK from Arbor Lodge, the home of J. Sterling Morton, the founder of Arbor day. Operation will be on the upper portion of the general class phone bands, 80 to 15 meters, and the upper portion of the 10 meter Novice phone band, from 1400Z on the 27th to 0000Z on the 30th. Send SASE to receive certificate suitable for framing. Use an 8½x11 SASE to receive unfolded certificate. Send QSLs to *Barbara Nihart, President, Nebraska Amateur Radio Club, 7731 Holdrege St., Lincoln NE 68505.*

DAYTON OH
APRIL 28

The Dayton/Cincinnati Chapter 9 QCWA (Quarter Century Wireless Association) will hold its Annual Banquet in conjunction with the Dayton Hamvention at Neil's Heritage House. COD Bar at 6:30, dinner at 7:30. Tickets are $13 each. Contact *Bob Dingle KA4LAU, 657 Dell Ridge Drive, Dayton OH* for tickets. Progress is underway for an interesting speaker for the evening. Come and join the fun. QCWA membership not required.

DAYTON OH
APRIL 29

The Miami Valley FM Association's 20th Annual B*A*S*H will be on Friday night in the Madison Room of the Hara Arena and Conference Center at 7 PM. No admission, continuous entertainment. Awards and dinner. *Miami Valley FM Association, PO Box 263, Dayton OH 45401.*

Special Events are listed free of charge as space permits. Please send your Special Event to *73 Magazine* two months before the monthly issue you want it to appear in. Please provide a concise, typed summary of essential information about your Special Event.

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Keyword Index Issue #342

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LETTERS

From the Hamshack

Maritime Net

In response to the letter from KA4WWG/MM3 in the December issue, I tuned in the Maritime Net on 14.313 MHz on Sunday morning, 18 December. All I heard for about two hours was people calling one another nasty names and making whistles and noises. I don't see how 14.313 could be of any use to anyone with all those long-winded, vulgar people on there. **Capt. Steve Smith, SWL**
Sunrise FL 33326

Steve—You must've caught the net at a rare time. The Maritime Mobile Net is noted for its efficient operation and its courteous participants. Keep listening!
. . . de NS1B

Epitaph Idea

While I am far from threescore and ten, when I become a silent key, I want my callsign on the tombstone. My callsign is just as much my identity as my name.
Steven O. Putman N8ZR
Fairborn OH 45324

Steve, are you laying some early plans for that great celestial DXpedition?. . . de NS1B

Invest in Ham Radio's Future

I find myself in total agreement with your remarks in the November "Never Say Die" column. I'm not currently active in ham radio, but am working on my Novice ticket. My renewed interest has been related to the new voice privileges as well as to a recent friendship with a ham operator. Although it should be obvious to anyone that the code is the main deterrent preventing that major increase in newcomers, it's not going to stop me from pursuing my license and encouraging others into the field. I would like to offer a couple of simple but effective ideas on how to stimulate interest into the arena of amateur radio.

I can't speak for other areas of the country, but around here anyone with questions about ham radio or looking for any help or advice on how to get started would be left out in the cold. There are no listings in any section of the phone book or classified ads. And if one were to monitor one of the local repeaters, you would get a very comprehensive update on ham news and calendar events, but no phone number that might put an interested person on the outside in contact with one on the inside.

Even access to the latest amateur radio publications is limited. This could easily be prevented if someone who is truly concerned about the preservation of ham radio were to sponsor a one-year subscription to *73*, to be displayed on the shelf of that local library.

Let's take advantage of the opportunities that would expand the number of amateur radio enthusiasts. In some cases, it would take less than 1 percent of one's equipment costs to invest in the future of amateur radio and in the future of our young people's minds.
Jeff Foster
Wyoming MI

Another Vote for No-Code

As a subscriber, I enjoy your magazine immensely, but I have written to convey my views as an "aspiring" amateur who, by choice, has yet to be licensed, thanks to the unyielding FCC code rule. Although I may not be qualified by amateur standards to judge the issue of a possible no-code license, I am qualified to have an opinion and, accordingly, I regard code as tedious, boring, and irrelevant to many aspects of amateur radio.

Our Canadian friends have recently established a precedent with their no-code Novice license which promises to attract many newcomers to the hobby. So, what is the big problem with the USA doing likewise? Is it the amateur community or the FCC (or both) who oppose a no-code license?

Several times I have heard the argument that the present code rule keeps so-called "undesirables" off of the amateur bands. Maybe, but this type of elitist reasoning, combined with the rules violations that I often hear on 10 meters, makes me wonder who the "undesirables" really are.

There are many talented 11 meter enthusiasts who could contribute to the collective pleasure, diversity, and enhancement of ham radio were it not for the archaic code regulation which they simply refuse to be force-fed, just to get a "ticket."

Oh well, someone once told me to find the grace to accept that which I cannot change, so, as the main characters in this code issue spew forth their glut of debate, I will comfort myself with continued 11-meter international contacts using 4 Watts and a Jo Gunn "Killer 8" antenna. . .without a "ticket!" 10-4?
Tom Bumpous ("Ironman")
Captain, USAR
Southwest Florida

Take Your Wife to Dayton!

This is a message to all those hams who, each year, kiss their wives good-bye, and then drive off to Dayton, to the largest congregation of ham radio operators in the world. And, they do so without the slightest regard to the storm cloud over her head.

Next year, take your wife along! There are two good reasons. First, she will enjoy it so much that she will overlook the numerous purchases you might be making. Secondly, she might become interested enough to become a ham herself, and share in the thrill of purchasing all those "goodies." Chances are, she'll be so thrilled with the Hamvention that she will also overlook the many Dayton shopping areas and leave the credit card intact. Intact enough for you to purchase any amount of the latest in electronic wonders.

The dazzle of Dayton begins when one realizes just how well organized the Hamvention is. No matter how uninterested you might be in the "di-dahs" and "da-dits," one can't help but be impressed.

Dayton also abounds with pleasures to be shared during those off-Hamvention hours. The city is laden with bike trails which will lead you around or out of the city. There are restaurants for every taste and, in the spring, the arts are in full bloom.

We returned to Dayton last year for the third time and found the event to be as delightful as ever. Ladies activities were, as usual, well organized and displayed a wide variety of creativity and hard work. For those who preferred to educate the mind, there were talks on genealogy, total health, walking for fitness, and stress and relaxation techniques.

And, wonder of wonders, I found myself looking over the forums suggested for those in the world of amateur radio. Always of particular interest to me are the workshops led by Wayne Green W2NSD, who is as adamant against smoking as both my husband and me.

I found myself wandering through the flea market displays totally amazed at some of the up-to-date equipment shown there. I watched, I listened, and I realized that some tiny seeds of interest were perhaps beginning to sprout. Who knows, by the time the next Hamvention rolls around, I might have my own call letters and it might be me who breaks the budget by purchasing the latest piece of equipment so necessary in the ham shack.

So, gentlemen, believe me—it's a "no win" situation if you leave your wife at home. She'll be spending money on her own local shopping trips while wondering why it is that you just had to have that latest piece of "junk." And, she'll certainly not come even one inch closer to realizing why you have this obsession with talking into a mike.

Taking your wife to Dayton might be just what any marriage counselor would order!
Linda Williams
Bedford PA 15522

Faulty Rigs?

During the recent CQWW phone contest, it seemed that many American amateurs had faulty rigs. The frequency readout apparently didn't give hams the proper frequency on the 10 meter band. This problem showed up only when the actual frequency was less than 28.300 MHz. When informed, most Americans were shocked or surprised to hear that they were out of band.

Sarcasm aside, in the past week on 10 meters, I counted 25 different American stations working or calling other stations on phone below 28.300. Too, I lost count of the number of times US CW ops informed me that *I* was out of band, QRMing beacons and CW ops. One station (a KD5) even cursed me for my flawed operation!

Why do I spend much time on 10 meters on phone below 28.300? Because I am a Canadian operating in Canada! We are allowed to operate phone from 28.100 to 29.700 MHz. When you think we are out of band, the truth is that you are (when on phone). When you throw a voice-mode signal on top of us, you violate your laws.

Not everyone is governed by FCC rules. Please remember that other countries have different rules! **Allen Linville VE6BEQ**
Edmonton, AB T5T-5H7
CANADA

TECH TIPS

Pearls of Tech Wisdom

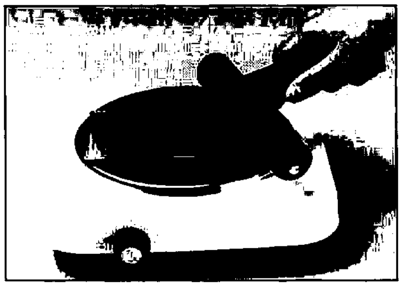


Photo A. Transfer the circuit pattern with a rubber roller.

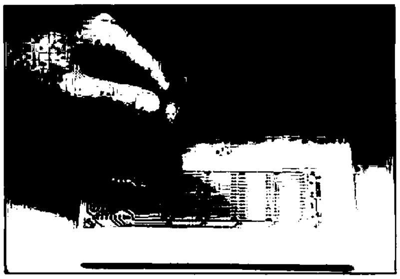


Photo B. After the board has cooled, pull the film off slowly and carefully.

For the Seeing Impaired

A blind amateur friend of mine had a hard time with his hand-held. I took a piece of Plexiglas ⅓" thick and cut it to fit over the keyboard. Next, I marked over each key and drilled ¼" holes. I mounted the Plexiglas so that it didn't touch the keys. I used double-sided sticky tape to hold the Plexiglas in place. Now the blind amateur can feel the holes, and push the buttons with his pen. The hand-held I did this on was the Yaesu 209AH, but I don't see why you can't make it work on other radios.

Garnet McKenzie VE6CFX
1746 17th St. S.E.
Medicine Hat, Alta.
Canada T1A-2B2

Improvement on the TEC-200 Process

Relative to the excellent article by W.C. Cloninger about making PCBs (August '87 *73*), I would like to focus on an improvement of the TEC-200 process described therein.

If you have any problems when transferring the circuit pattern with a hot iron, try the following method:

1. Put the film with the photocopied pattern onto the copper-clad board and fix it at one end with an adhesive strip.

2. Put this copper-clad board on a heating plate or on a hot iron turned upside down, and heat the board to 130–140°C.

3. Transfer the circuit pattern with a rubber roller. Applying slight pressure, roll it to and fro (see Photo A). Such a roller is available from photographic or art and craft suppliers.

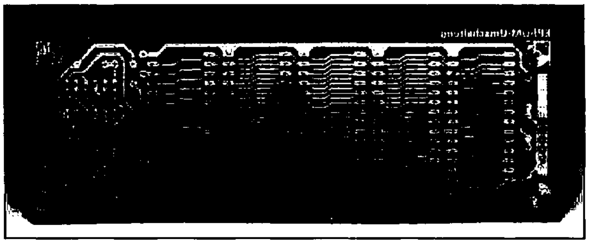


Photo C. The finished board—very clean and professional-looking.

Using this technique, even very fine pattern lines will be perfectly transferred. After the transfer stage, when the board has cooled, pull the film off slowly and carefully (see Photo B), leaving the circuit pattern adhering to the board. Now the board is ready for etching.

The quality of the finished board speaks for itself (see Photo C).

Dr. Roland Milker DL2OM
Finkenweg 14
5457 Oberhonnefeld
Germany

Easy Precision Resistors

Paralleling or series-ing resistors to get non-standard values can be frustrating. Here is a quick and easy way to get any resistance value you want, of any wattage, with its tolerance limited only by your ohmmeter.

Your electric drill, rotary engraving tool, or whatever similar tool you have, and a common grinding bit or steel cutter are the only tools required. If you have none of these, you can do the job by hand with a small round file.

Here's how: Select a composition or carbon resistor of lower value than your target resistance. Lay it flat on a solid surface with ohmmeter leads attached. Grind away the outer surface of the center of the resistor body in one spot, making a nice concave niche. As you approach the actual resistance element at the core of the resistor, go carefully. Monitor the ohmmeter, which will rise in value as you remove bits of the element. Go slowly so you do not overheat the element, giving a wrong reading.

When your ohmmeter indicates the target resistance, stop grinding and give the resistor a few seconds to stabilize. If it now reads the proper value, coat the groove with clear fingernail polish for water resistance.

I have successfully used this technique and have experienced no long-term ill effects. The whole process takes about three or four minutes.

Bill Bibings W8DZQ
260 Water Street
Otsego MI 49078

Have a Tech Tip?
Send it in! Authors of printed Tech Tips receive a free one-year subscription to *73 Magazine*.

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

You may recall being promised a ***list of Hambassadors****. If you do remember, please be patient. It will appear as soon as you stop sending in interesting stuff that takes up all the space—or sooner.*

When it does appear, at least two new names will be on the list: An ***Australian****, from whom we expect final OK anytime, and Woodson Gannaway N5KVB/EA—not N5KUB/EA as we mistagged him in his first appearance here, in February. His home call is from Arkansas: "We sold my welding business to move here [****Canary Islands****] as Bahá'í pioneers [two years ago]. My dream of being a ham started in the late 1950s when a sympathetic friend lent me a BC-348 receiver during an extended childhood illness. It took me nearly 30 years to do something about it (and I still remember using the BFO to understand SSB). I'm teaching English and learning to make the distinctive Canary knives the old-fashioned way here. I expect to start giving guitar lessons next year, after I brush up a little more. Oh, yes; in the U.S. I also abstracted a lot of technical articles for the American Society for Metals. . . I look forward to [being a Hambassador]." Woodson will cover events in the Spanish-owned Canary Islands and also be Honorary Hambassador for Spain—honorary because he will "retire" when (if) a Spanish national volunteers for the post.*

Italy *was honored recently when Commission member (of the 17-member European Commission for the* ***European Economic Community—the EEC****), Sr. Filippo Maria Pandolfi, was named Commissioner for R & D and telecoms and information technology. We will be much interested to hear (from anyone, anywhere) of any developments in (or affecting) any of the 12 member nations of the EEC, which will have an impact on amateur radio—there are bound to be such developments between now and the end of 1992. That is when it is anticipated that Europe will have become a very special, united, community.*

April calendar. Special calendar note about Japan: *April 29 is the holiday honoring the birthdate of the late Emperor Hirohito. This will be a good day on which to express sympathy for Japan during any OSO. Year One of the Heisei era ("Achieving peace on heaven and earth,"—see characters for this at left) began on Sunday (10 a.m. EST, January 7) under Emperor Akihito.*

平
成

Other April occasions for mention during OSOs: 1—Youth Day, Benin; 2—Malvinas Day, Argentina, International Children's Book Day; 3—National Day, Guinea (9th for Sierra Leone, 27th for Afghanistan and Togo); 4—Liberation Anniversary, Hungary, Independence Day, Senegal (18th for Zimbabwe); 5—Arbor Day, South Korea; 6—Victory Day, Ethiopia (24th for Togo); 7—World Health Day, Womans Day, Mozambique; 11—National Heroes Day, Costa Rica; 12—National Redemption Day, Liberia; 14—Pan American Day, and Happy New Year, Bangladesh! 15—Military Regime Anniversary, Niger; 16—Queen's Birthday, Denmark, National Secretaries Week begins, USA; 17—Evacuation Day, Syria; 19—Republic Day, Sierra Leone; 23—St. George's Day, England; 25—Liberation Day, Italy and Portugal, Anzac Day, Australia and New Zealand; 26—Union Day, Tanzania; 27—HAPPY BIRTHDAY, SAMUEL F. B. MORSE! (FB!); 28—Arbor Day, USA; 29—Emperor Hirohito's Birthday; 30—Queens's Day, Netherlands, King's Birthday, Sweden.

ISRAEL

Ron Gang 4X1MK
Kibbutz Urim
Negev Mobile Post Office
85530 Israel

This **year's special operation for the Spring** by the Israel Amateur Radio Club takes on an interesting historical twist. Between the years 1099 and 1291, the Crusaders ruled this country and set up a series of fortresses from the Red Sea on up into Lebanon. Today, ruins of these massive fortifications and castles can be found in strategic places all over the land and are well-known to those who enjoy excursions and touring in Israel.

One hundred hours of IARC operations in April will take place in four different such places: Yehiam in the Galilee, Caesarea on the Mediterranean coast, Belvoir (Kikhav HaYarden) overlooking the Jordan River valley south of the Sea of Galilee, and Ashkelon in the south, also on the Mediterranean. In most places there are youth hostels or kibbutz guest homes, so those who do the operating will enjoy socializing during the event; and visitors from abroad will be most welcome.

At the IARC raffle of gear, for the benefit of the club treasury. L to R: Naomi 4X6DW, Tuvia 4X4GT, and Yankele 4X4AH.

The operation will start at 0800 UTC on Friday, April 21, and will last exactly 100 hours to 1200 UTC, Tuesday, April 25. Each station will have a special callsign, and a certificate will be available for those contacting all four stations. [*Specific information was not available at press time.—CCC*]

Israel Repeater Update. Visitors from abroad are most welcome on our repeaters, most of which need either a 192.8 Hz or 91.5 Hz PL tone to access them. (For reciprocal licensing details see the information given in the December, 1988, "73 International" column.) VHF repeaters have a −600 kHz shift, 70 cm shifts are 7.6 MHz down (see box for list). The packet network is on 144.675 MHz, with very wide coverage through various digipeaters around the country (see the following paragraphs).

The Israeli Packet User's group had its second annual meeting in December, in Natanya. (Thanks to Shlomo Goldstein 4X4LF for the following information.) Bentzi 4X1IL presented a resume of 1988 activities. More than 80 stations are on packet and three digipeater stations are in operation—4X4HF in Haifa, 4Z4SV in Shoresh Village near Jerusalem, and 4X1IL in Herzlia, which

ARMENIAN EARTHQUAKE
A Roundup of Information As It Comes In

From Ed Kritsky NT2X. Our Hambassador for the USSR, Gennady Kolmakov UA9MA, became involved immediately. Look for a full report for this in a future issue.

From Ron Gang 4X1MK. Along with all the international aid pouring into earthquake-stricken Armenia, three Israeli Air Force Hercules transport planes flew in the Israeli assistance team. Our people included medical staff who set up a field hospital, and a crew of evacuation experts who had already been seasoned by experience in extracting people from under collapsed buildings in both Lebanon and the Mexican earthquake disaster.

Although our small country's contribution to the huge efforts made to save lives was quite limited relative to the scope of the operations, the ancient Talmudic proverb states, "He who has saved but one life, has saved an entire universe." And indeed, the Israeli evacuation and medical teams' work was far from insignificant, as was duly noted by the Soviet news media.

Amongst the crew members was Yaron Kedmi 4X6AJ, who was heard on the skeds as 4X6AJ/UG6, relaying messages back home on 20 and 40 meters. It is interesting to recall that a year ago Soviet amateurs still were not permitted to speak with us, Israel having been on the USSR's banned list since 1967. Now, with the apparent dawning of a new enlightened age, things are changing rapidly as we witness increased international cooperation and understanding.

ISRAEL'S REPEATERS

VHF (−600 kHz shift)

145.300 Haifa RTTY, FM
145.325 Beersheba
145.350 The Galilee
145.375 Tel-Aviv
145.400 Natanya
145.600 The Coastal Plain
145.625 Jerusalem
145.675 Haifa
145.775 Tel-Aviv

Open Access 70 cm.
(−7.6 MHz shift)

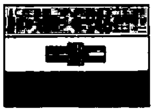
438.650 Tel-Aviv
438.600 Haifa

also acts as an HF gateway for the VHF national network. Two more are planned, one in Safed to cover the northern region, and the other in Mitzpe Ramon to cover the south all the way down to Eilat, thus covering the entire country. The IARC has been of great financial assistance, and a UHF link is planned to ease the traffic on 144.675—and also to allow the Novices, who are relegated to 70 cm., to get in on the fun.

Jim Stone 4X1RU described the operation of his BBS, which is the packet link between the Far East and Europe and North America and is averaging 70 bulletins/messages a day. He explained the problems encountered using packet on HF and detailed the experiments he is carrying out in an effort to solve them. Naftali 4Z4RM outlined the problems of some models of TNCs and recommended installation of the MF-10 filter in those not already using it. Ofer 4X6OJ described the AX.25 protocol's deficiencies, and ways of overcoming them.

Peleg Lapid 4X1GP discussed how bulletins and messages arrive at the BBS via HF, various information networks, and satellite networks. The new PACSATs due to be launched this year will add a new dimension to packet operation, and their store and forward capability should enable them to replace the present HF links.

Commemorative cups were presented to Jim 4X1RU and Yossi 4X6JP for their outstanding achievements in advancing packet radio in Israel, and there was general discussion about the need for portable packet in such situations as the Armenian disaster. [*See earthquake information box in the Roundup section, above.—CCC*] A need for assistance for hams wanting to get into packet was expressed; possibly a course can be organized for weekly meetings.



SOUTH AFRICA

Peter Strauss ZS6ET
PO Box 35461
Northcliff, ZA-2115
Republic of South Africa

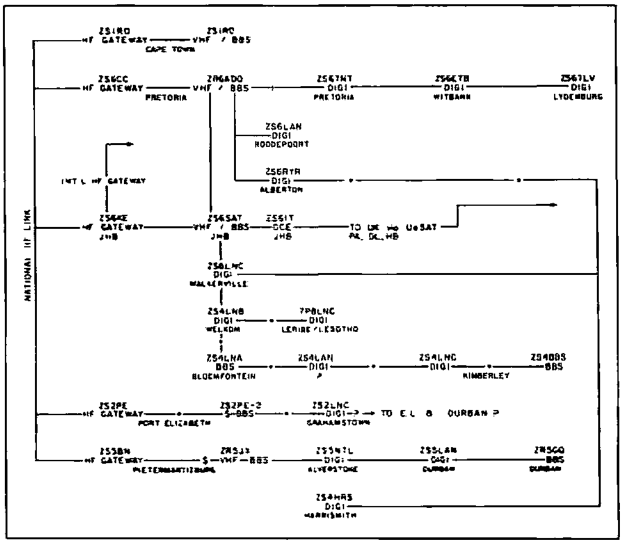
Packet Radio in South Africa. The origins of Packet Radio go back to two organizations: SAATI and SAAMSAT. SAATI, the South African Amateur Telecommunications Institute, started as an organization promoting RTTY, distributing surplus RTTY equipment, and offering kits and projects. SAATI now offers TNC kits and operates a digipeater, and its members operate a BBS.

SAAMSAT, through the international connection with AMSAT NA, AMSAT UK, AMSAT DL and the University of Surrey, became involved in the DCE project linking the ZS6SAT BBS in Johannesburg via UoSAT 11 to the BBS world in the UK and Europe.

The 2-meter user-accessible BBSs in Cape Town, Johannesburg, Pretoria, Durban, and Port Elizabeth are linked via HF, and digipeaters in the metropolitan areas enlarge the coverage. Projects on the drawing board are a link from Johannesburg to Lesotho (7P8), and a link from Johannesburg/Pretoria to Durban. Further BBSs are presently under construction. User access is via 144,650 and 144,675 MHz.

Four digipeaters operate in Level III mode with the balance still in Level II. As traffic density increases, most can be expected to be upgraded to Level III. The introduction of backbone links with higher baud rates will follow. Special permission to use 9600 baud for the linking of such digipeater sites has already been granted by the license authority. Maybe 10 GHz link channels with multiplexed data and voice can be implemented before the end of 1990.

In addition to the DCE link, the expansion of HF data exchange with other international HF BBSs is sought on a regular basis. The lack of HF BBSs in Africa, and often marginal propagation conditions towards the Far East, Europe, and the USA make the linking through HF on a reliable basis a difficult task for sysops in South Africa. Until his return to the USA during June, 1988, an amateur located in Tanzania provided a very valuable BBS for Africa.



South Africa/Lesotho packet network chart. (Existing KAM to upgrade to MBL BBS.) Information compiled by ZS6ET as of September 27, 1988. Symbols are: — link, $ BBS, -*- proposed link, -$- proposed upgrade, -?- uncertain link.

The liaison between SARL, SAAMSAT, and SAATI in the field of packet radio is conducted through the Packet Radio Working Group (SARL PWG). Meetings are usually held once each month at the Johannesburg Amateur Radio Center (JARC). Such meetings prevent the duplication of services and projects and encourage the pooling of resources and manpower. Frequency planning proposals for packet applications are made and, in the case of the Transvaal Province with its high population density, forwarded to the TTCC, the Transvaal Technical Coordinating Committee. The TTCC is a SARL Interbranch Committee planning the use of repeater frequencies.

If you would like to see more facts about South Africa please write to me. I have a FREE video film in NTSC VHS and BETA available. The airmail charges and packing are only US$10. *Sorry, no personal checks can be accepted!* Please indicate the standard of your choice when requesting your copy.

GOLDEN CITY AWARD
(Certificate illustrated last month)

The Golden City Award is issued to applicants who have made the specified number of two-way contacts with stations in the Greater Johannesburg Area (KG43). DX amateurs, SWLs, require five contacts. Endorsements may be applied for (CW, SSB, EME, RTTY, Satellite, SSTV, etc.). No time restrictions.

The cost of the award and airmail service is US$5 or 10 IRCs. Submit certified logs to the Awards Manager, SARL Johannesburg Branch, PO Box 2327, Johannesburg 2000, Republic of South Africa.

1989 INTERNATIONAL DX CONVENTION

April 21, 22, 23, Visalia, California

Sponsored by the Northern California DX Club and the Southern California DX Club, Holiday Inn, Plaza Park, Visalia. Pre-registration deadline (US$40 rate) March 20 postmark; US$45 thereafter. Holiday Inn Convention Rate rooms until April 6—call Area Code 209, 651-5000. Send registration fee to **Dave Engle KE6ZE, 1063 Summerwood Court, San Jose CA 95132.** Chairman: Bill Zachman W6TPH. Other Committee members: W6VG, KD6AZ, WB6WKM, KN6K, N6ST, K6TMB, KA6W.

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QSLs & RUBBER STAMPS—TOP QUALITY States. World Maps. USA. Key. Shuttle. Globe QSLs. Report Form Rubber Stamps. More! Samples, $1.00. [Refundable with Order.] Ebbert Graphics D-7, Box 70, Westerville OH 43081. BNB807

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MAGAZINES WANTED: "Microwave Systems News" (MSN), "RF Design," "PCIM (Power Conversion & Intelligent Motion)," and "QEX" (1980-present). Call collect 519-742-4594 (Ontario) after 6 PM Eastern time. BNB841

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100 QSL CARDS $8! Shipped postpaid. Free samples. Shell Printing, KD9KW, PO Box 50A, Rockton IL 61072. BNB859

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WANTED: Copy of AMTOR PROM chips for Micrololog ATR-6800. Company no longer supports this equipment. Will pay reasonable price. P. Malloy, PO Box 155, Limestone ME 04750. BNB862

C64 SOFTWARE. Schematic & PC Board Fonts, Electronic Programs & Dictionary. For C64 or C128 with Geos.™ Send $19.95 or write: Thomas Software, 1375 Beaseley Rd., Jackson MS 39206. BNB863

HOSSTRADERS flea market returns to Deerfield NH June 3. SASE for info. WA1IVB, RFD Box 57, West Baldwin ME 04091. BNB864

THE NATIONAL HAM SHOPPER. A bi-monthly buy, sell, trade publication (starting in April). Adds are quickly answered and published for fast results. $12/per year. $22.00/per 2 year subscription rate. Ad rates 0.30/word individuals; 0.90/word commercial. Send to PO Box 10738, Elmwood CT 06110. BNB865

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NICADS QUICK CHARGE "AA" 500 mAh. 10 for $12.00 plus $1.85 shipping; "AAA" 4 for $5.50, US made silver teflon PL259, 10 for $15.00 plus $1.85 shipping. Raymond Richard, 5113 Town Ridge, Middletown CT 06457. BNB867

COMMODORE VIC-20 COMPUTER mint condition—$49. Postpaid, R. Christie, 215-28 Spencer Ave., Queens Village NY 11427. BNB868

HANDICAPPED NOVICE needs HF equipment donated—anything, please. KA3OVE, (412) 531-7443 anytime. BNB869

THE 11TH ANNUAL TSRAC WHEELING HAMFEST/COMPUTER FAIR, Sunday, May 21, Wheeling Park, 8 AM to 3 PM. WV's largest hamfest. Dealers welcome, under roof. Free flea market, admission only. Family Hamfest: WOMEN FREE, Children 14 under free. Admission $3.00 in advance—$4.00 at door. Contact: TSRAC, Box 240, RD 1, Adena OH 43901. (614) 546-3930. BNB870

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ICOM R7000 RECEIVER New in carton, $800. AEA PK 232, New with instructions, $200. D. DuVal; 11 Virginia Place; Larchmont NY 10538. (914) 833-0008. BNB872

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Number 39 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8½" x 11") sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Thank you for your cooperation.

Has anyone transistorized Heathkit's HG 10B VFO? Tubes: 6CH8 cathode follower oscillator, OB2 voltage regulator. Any modifications on the HR10B receiver or DX60 Transmitter would also be appreciated.

K. Neal
HCR 62-222
Flippin AR 72634

I need operation or service manuals for a linear amplifier, type CL-11, from Communications Associates, Inc.,and for a frequency counter, Model 1500A, from Monsanto. I will pay for use and copying costs. Does anyone have current addresses for these companies?

Mike Adams N4EVS
6333 Hwy. 2321, Deer Point
Panama City FL 32404

Does anyone have a schematic or information on the serial RS232 board (RS PN. 26-1145) used in the TRS-80 Model I? I need this board so that I can get on RTTY.

Dan R. Johnson KG4MD
U.S. Naval Hospital
Box 36
FBPO Norfolk VA 23593

Need Manual and/or schematic for the Lafayette HA-600A receiver. Will pay costs.

John Stryker N2IKX
RD #4, Box 219
Hammonton NJ 08037

I need a schematic, parts list, or information on a Klitzing UHF linear amplifier, Model 70CM10W60A. I will gladly pay postage and copying costs. Thank you.

Allen Fugelseth WB6RWU
4230 Trotter St.
Capitola CA 95010

Want commercially made printed circuit board for the "CMOS SUPER KEYER" as described in the 1988 ARRL Handbook section 29-3. also want service manual for U.S. Army "Terminal Telegraph 1H-5/TG."

Lionel L. Sharp VK4NS
19 Kelso St.
Chermside, Brisbane
Queensland Australia

We are a middle school of 1100 students, with over a hundred students interested in starting up a ham club. This club will be worked into a class in the Fall '89 semester. We are looking for any type of amateur radio equipment and publications. We are also looking for amateur radio software to run on an IBM PC.

Craig Hardy KB5EFG
Donny Bickham Middle School
6470 Old Mooringsport Rd.
Shreveport LA 71107

Number 40 on your Feedback card

QTH-DX

QTH Antarctica

Leon Fletcher N6HYK
274 Webster Drive
Ben Lomond CA 95005

Brent Jones KB1UK, who for most of this year is operating as KC4AAA from the United States' Amundsen-Scott South Pole Station, spends nearly all his time inside a geodesic dome 164 feet wide, 53 feet high.

"In this protective dome," he told me during a rag-chew on 15 meters, "the temperature stays around minus 35 degrees Fahrenheit." Jones considers that frigid indoor clime "comfortable." Outside the dome, temperatures average minus 76 in the deep winter of July, and get as low as minus 117. The warmest day ever was only 3.1 degrees F.

The dome covers three modular buildings. One houses the galley, dining hall, and some recreational facilities. Another structure contains most of the berthing. The third, the "Science Building," contains the laboratories in which scientists research such fields as glaciology, geophysics, meteorology, and upper atmosphere physics.

Outside the dome, a quarter-mile away, are Quonset-type buildings, covered with canvas-like material, which provide living quarters for the additional scientists who come during the summer.

But during the winter—between mid-February and early November—the station is completely isolated. Not even mail gets in or out. That isolation is eased greatly through hamming. Phone patches to stateside relatives and friends are one of the highlights of life in Antarctica. And in the United States, numerous hams are on the air—some regularly, some occasionally—to handle the patches, usually around 14,240 to 14,250 kHz, at about 0300 UTC.

Land of Extremes

It's understandable why hamming would be popular here in this harsh, desolate land. A spokesman for the National Science Foundation, Walter Seellg, says that, of all the continents, Antarctica is "The coldest, windiest, highest, and driest."

The statistics behind those claims are startling.

•Coldest: Antarctica holds the all-time world record for cold—minus 126.9 degrees F, recorded in Vostok on August 24, 1960. Antarctica averages 20 degrees F colder than the Arctic.

•Windiest: the strongest winds in the world—up to 200 miles an hour—blow through Antarctica's Cape Denison, nicknamed "Home of the Blizzard."

•Highest: Antarctica is more than four times higher than any other continent. Its average altitude is about 14,000 feet, including an 8,000-foot cover of ice and snow.

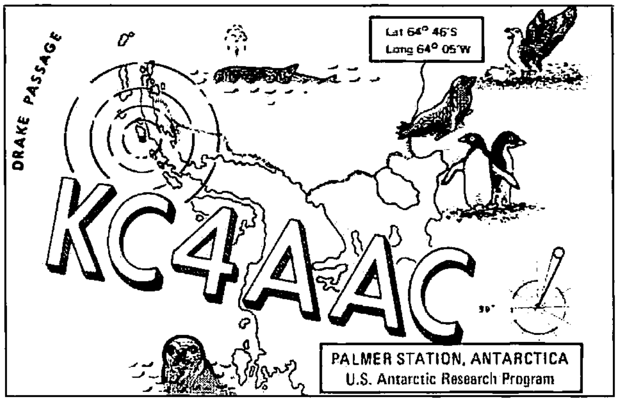
•Driest: it rarely rains in Antarctica. Even the snow, when melted, totals only about 10 to 20 inches of water a year in the wettest areas, along the coasts. Scientists estimate the average amount of precipitation over the entire continent to be only two to four inches per year.

One Country, Many Prefixes

Hamming from Antarctica, according to the ARRL's latest "DXCC Countries List," can come from at least 14 different prefixes. The named prefixes are:

ATØ (India)	VP8 (Britain)
CE9 (Chile)	Y8 (Indonesia)
DPØ (Germany)	ZL5 (New Zealand)
FT8Y (France)	ZS1 (South Africa)
KC4 (USA)	ZXØ (Brazil)
LU (Argentina)	3Y (Norway)
OR4(Belgium)	4K1 (USSR)
VKØ (Australia)	8J1 (Indonesia)

Despite the array of prefixes, all of Antarctica counts—under ARRL rules—as just one DX country. Yet claims to territorial sovereignty in Antarctica, according to a U.S. Department of State publication, have been made by seven countries: Argentina, Australia, Chile, France, New Zealand, Norway, and the United Kingdom.



History, Geography, Flora, and Fauna

Exploration of Antarctica began about A.D. 650, according to "credible legends among Polynesians," as historian William Bixby puts it. That's when islanders in a large ocean-going canoe became the first humans to sight the ice of this strange continent.

In 1772–1775, English explorer James Cook was the first to sail completely around Antarctica, but he never saw the landmass itself. The first sighting didn't happen until nearly 50 years later, on January 30, 1820, when British naval officer Edward Bransfield explored the area.

Ninety-one years after that, the ultimate was attained. On December 14, 1911, a Norwegian expedition led by Roald Amundsen was the first to stand at the South Pole. But it was only 31 years ago, on March 2, 1958, that the first crossing of the continent was completed by British explorers led by Vivian Fuchs.

Antarctica is almost circular and covers 5.4 million square miles, about the size of the continental United States and Mexico. It contains nearly ten percent of all land in the world. Its 18,648-mile coastline is more than 50 percent longer than that of the United States.

Because temperatures rarely get above freezing, the continent is virtually lifeless. It has no forests, brushes, or grasslands. The vegetation—mostly lichens, bryophytes, and algae—rarely grows to over two inches high. But there are almost 400 species of mosses, and about 200 species of freshwater algae.

Animal life is somewhat more abundant. There are 17 species of penguins, including three found nowhere else: the Adelie penguin, the most common of ail birds in the Antarctic; the Chinstrap, the smallest penguin; and the Emperor, the largest, growing to about 38 inches tall and weighing up to 80 pounds. Other species of birds include gulls, terns, and albatrosses. Seals used to be plentiful in the waters off Antarctica, but by the 1850s, commercial hunters

"Antarctica is the coldest, windiest, highest, and driest (continent)."

had killed all of the continent's fur-bearing seals.

Whales still abound in Antarctic seas, despite mass killings by the whaling industry. The largest animal known to have existed in the world was a giant blue whale caught off Antarctica: It was 124 feet long and estimated to weigh about a ton a foot.

The natural resources of Antarctica are considered to be the most worthless of all the continents. There are traces of nickel, copper, iron, gold, and other minerals, but not enough of any of them has been found to make mining worthwhile.

The Future

Nevertheless, research continues. All activities must be "exclusively for peaceful purposes," according to the Antarctic Treaty of 1959, signed by 12 nations and later endorsed by 26 additional countries. Military bases, fortifications, nuclear explosions, and disposal of radioactive waste are specifically forbidden.

The latest published report says that Antarctica has 52 year-round scientific outposts, representing 14 countries. The United States maintains four year-round research centers: McMurdo, the largest; Siple, the smallest; Palmer; and the South Pole station.

Presumably, all the staffers at all those stations would agree with James Cook, that first Antarctic explorer, who described the area as "Lands doomed by nature to perpetual frigidness. . . whose horrible and savage aspect I have not words to describe." ■

Number 41 on your Feedback card

PROPAGATION

by Jim Gray W1XU

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Good DX Activity

April will be nearly as good as March with respect to HF propagation. All the HF bands will be very active during the day, and most will continue to provide good DX until long after dark—including 10 meters! Six meters will close around or shortly after dark, but you can expect superb 6 meter DX on many days of the month.

Solar flux will be high during most days, but the penalty for an increasingly active sun will be frequent flares and major solar events, all of which adversely affect the earth's magnetic field. This means that, although the solar flux will greatly enhance the ionosphere, an active magnetic field surrounding earth will prevent many DX contacts to those areas where you most want them. However, the north-south paths will be open and transequatorial propagation will be good on those days when east-west and over-the-pole propagation won't be available on bands above 40 meters.

Ionospheric Disturbances

The biggest problem we will have to face is some very disturbed ionospheric and possibly geophysical upsets (storms, volcanism, and earthquakes) during the first week of the month. The earth's magnetic field will possibly reach storm levels that week, notably from the 1st through the 7th, and most days the magnetic field will be unsettled-to-active, at the very least.

Typical of unsettled-to-active magnetic field conditions, propagation will be "spotty" on all bands. There will be frequent "echo" signals on bands above 30 meters and "blackouts" on some bands on a couple of days due to solar flares. This is not to imply that all of these conditions will occur each day, but it does mean that you can expect any one, or a combination of these conditions, during this period.

Excessive Ionization

Readers should note that the ionosphere can become too ionized. This causes signal absorption on the lower bands (80, 40, 30) during the day, and these bands won't even begin to sound good until after dark or late afternoon at the earliest. It seems that you can't have everything all at the same time when it comes to good DX "conditions." For best results on 160–30 meters, try early mornings and early evenings.

Note that, when making forecasts at least three months in advance of the time we're considering, it isn't possible to tie any single event to a particular day. The best we can do is to indicate a period within a week that is likely to exhibit the phenomena indicated on the chart.

The rest of the month is likely to be very good, with the exception of a day or two on either side of the 21st, when conditions will be only fair, and possibly poor for one day.

Looking Back (or Ahead?)

It's always interesting to look at the predictions made several months ago. As I write this column, it's mid-January, and I have the opportunity to evaluate my predictions to see how January followed the forecast. One thing is immediately apparent: The propagation is even better than I had expected. I mentioned that solar flux values would be holding well above 150. I didn't expect them to be well above 250! On a couple of days we had values above 290!

Otherwise, so far the forecast is bearing up pretty well under the load of facts. Last week (between the 9th and the 16th) conditions did exhibit very high "A" index values (A = 27 on one or two days) as predicted, and there were very unsettled-to-active magnetic field conditions.

The VHF/UHF contest is in full swing this weekend as I write, and, also as predicted, there have been some good openings.

Looking back over the month's predictions, I find that some were remarkably and even exactly "on target," while a few missed entirely. All in all, it is 80% accurate, which, given the present state of our knowledge, is about the best we can hope for.

Meanwhile, have fun, and, as always, keep that radio tuned to WWV at 18 minutes after each hour to keep up with propagation and solar-geophysical events. See you next month. Good DX!

APRIL

SUN	MON	TUE	WED	THU	FRI	SAT
						1 P
2 F–P	3 F–P	4 F–P	5 P	6 P	7 P–F	8 F
9 F	10 F–P	11 P	12 P–F	13 F–G	14 G	15 G–F
16 F–G	17 G	18 G–F	19 F–P	20 F	21 F–G	22 G
23 G / 30 G	24 G	25 G	26 G–F	27 G	28 G	29 G

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	06	10	12	14	16	18	20	22
ALASKA	15	20	–	–	–	–	–	20	–	–	–	–
ARGENTINA	15	20	20	20	40	–	–	–	15	10	10	10
AUSTRALIA	15	20	20	20	20	–	40	20	–	–	–	15
CANAL ZONE	20	20	20	20	40	–	–	15	15	10	10	10
ENGLAND	–	40	80	40	–	–	20	15	15	10	15	20
HAWAII	15	15	20	20	40	40	40	20	20	–	–	10
INDIA	–	–	–	–	–	–	–	–	–	–	–	–
JAPAN	15	20	–	–	–	–	–	20	–	–	–	–
MEXICO	20	20	20	20	40	–	–	15	15	10	10	10
PHILIPPINES	–	–	–	–	–	–	–	20	–	–	–	–
PUERTO RICO	20	20	20	20	40	–	–	15	15	10	10	10
SOUTH AFRICA	20	–	40	–	–	–	–	–	–	10	15	20
U. S. S. R.	–	40	–	–	–	–	–	20	15	20	–	–
WEST COAST	15	20	20	40/80	80	–	–	–	–	15	10	10

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	06	10	12	14	16	18	20	22
ALASKA	15	20	20	20	–	–	40	20/40	20	–	–	–
ARGENTINA	15	15	20	20	40	40	–	–	–	–	10	10
AUSTRALIA	15	15	20	20	20	–	40/80	40/80	–	–	15	15
CANAL ZONE	10	10	20	40	40	40	–	15	15	10	10	10
ENGLAND	40	40	–	–	–	–	–	20	15	15	15	20
HAWAII	10	15	20	20	40	40	–	20	20	15/20	15	10
INDIA	–	–	–	–	–	–	20	20	–	–	–	–
JAPAN	15	20	20	20	–	–	40	20/40	20	–	–	–
MEXICO	10	10	20	40	40	40	–	15	15	10	10	10
PHILIPPINES	15	15/20	–	–	–	–	–	20	20	–	–	–
PUERTO RICO	10	10	20	40	40	40	–	15	15	10	10	10
SOUTH AFRICA	20	20	–	–	–	–	–	–	15	15	15	15
U. S. S. R.	–	–	–	–	–	–	–	20	15	15	20	–

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	06	10	12	14	16	18	20	22
ALASKA	10	15	20	20	20	20	40	40	–	–	–	15
ARGENTINA	15	20	20	40	–	–	–	–	–	–	10	10
AUSTRALIA	10	15	20	20	20	–	40	–	20	20	–	15
CANAL ZONE	20	20	20	40	40	–	–	–	15/20	15	10	10
ENGLAND	–	–	–	–	–	–	–	–	20	20*	20*	20
HAWAII	10	15	15	40	40	40	40	40	–	20	20	20
INDIA	–	15	15/20	–	–	–	–	–	20	–	–	–
JAPAN	10	15	15	20	20	20	40	40	–	–	15	15
MEXICO	20	20	20	40	40	–	–	–	15/20	15	10	10
PHILIPPINES	15	15	20	20	20	–	–	–	20	15/20	15/20	15
PUERTO RICO	20	20	20	40	40	–	–	–	15/20	15	10	10
SOUTH AFRICA	20	20	–	–	–	–	–	–	–	–	15	20
U. S. S. R.	–	–	–	–	–	–	–	–	20	–	–	–
EAST COAST	15	20	20	40/80	80	–	–	–	–	15	10	10

73 AMATEUR RADIO

International Edition

MAY 1989
ISSUE #344
USA $2.95
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A WGE Publication

Goldwater for No Code!

(see QRX)

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Feedline phase selector
Inexpensive Mode S!

Reviews:

Pick from AMSAT's trackers
Ephemeris tracker program
Kenwood's latest OSCAR rig

PLUS:

Students and OSCAR
Virtues of Phase III D
...and much more!

Welcome, Newcomers!

You are about to embark on a journey into the fascinating hi-tech world of satellite communications. It won't cost thousands of dollars, and you don't even need a satellite TV dish. Just bring an open mind and an active curiosity.

The space age began on October 4, 1957, when Sputnik 1 achieved orbit and became the world's first artificial satellite. International tensions rose, but so did the excitement as scientists and engineers speculated on the potential of this man-made orbiting device. This was a radio in space. Hams took note.

A year and a half later, Don Stoner W6TNS mentioned a solid-state six-to-two meter repeater with solar power in his "Semiconductors" column in the April 1959 issue of *CQ Magazine*. The repeater was to be lofted by balloon over the Southwest. Don wrote, somewhat tongue-in-cheek: "Can anyone come up with a spare rocket for orbiting purposes?"

On the morning of December 12, 1961, OSCAR-1, amateur radio's first "hamsat," began transmitting from space. That was 27 years ago.

Today we have several hamsats. All have telemetry output, and many have transponders for communications. Earth stations range from shortwave to UHF and microwave systems. These stations have been built by amateur radio enthusiasts all over the world: UoSAT's from Great Britain; Fuji from Japan; RS units from the USSR; OSCARs by the U.S., West Germany, and others. They are in orbit *now*, just waiting for you to join the fun and use them.

In this special satellite issue you will find construction articles, tracking software and equipment reviews, satellite profiles, and informational topics on all facets of the amateur satellite program. Details of the program's history can be found in the ARRL Handbook and *The Satellite Experimenter's Handbook*. Our purpose is to show you how to get on the satellites today, and what to expect tomorrow.

Several new satellites are being readied for launch this year. Packet radio from space, digitized TV pictures from low-earth orbit, voice synthesizers with two meter FM downlink operation, and other modes, will make 1989 a banner year for AMSAT and its internationally affiliated organizations.

Care to know more? Read this issue! It's all here. You may find that your shack already has all the equipment needed for full-duplex amateur radio satellite activity. Join the fun in using the highest repeaters around. Make your next contact an OSCAR contact.

...de WA5ZIB

GLOSSARY

AMSAT—The Radio Amateur Satellite Corporation, whose purposes include satellite construction and education as a non-profit, membership-funded entity. For details call (301) 589-6062, or write to P.O. Box 27, Washington DC 20044.

AOS—Acquisition of Signal. When the satellite has appeared above your horizon for a pass.

A-O-10—AMSAT-OSCAR-10. The first amateur high-orbit communications satellite, launched in 1983.

A-O-13—AMSAT-OSCAR-13. Our newest and most complex amateur high-orbit communications satellite, launched in 1988.

Apogee—A satellite's position when it is furthest from the earth's surface.

Doppler Shift—The apparent frequency shift of signals as retransmitted through a satellite transponder.

Downlink—The space-to-earth signals coming from a satellite.

F-O-12—Fuji-OSCAR-12. An amateur radio satellite built by hams in Japan and launched in 1986 on a Japanese rocket.

Full Duplex—The ability to listen to your own signals as retransmitted via satellite.

Hamsat—Another name for an amateur radio satellite.

Keplerian Elements—A set of numbers used to define a satellite's orbit. Most tracking software requires input of these numbers to determine satellite availability.

LOS—Loss of Signal. When the satellite has completed its pass and has fallen below your horizon.

Mode—A letter description of a particular uplink/downlink frequency combination for a satellite transponder. For example: Mode "A" defines a two meter uplink and ten meter downlink operation.

OSCAR—Orbiting Satellite Carrying Amateur Radio.

Perigee—A satellite's position when it is closest to the Earth.

RS-10/11—The newest Soviet hamsat offering. These two devices are a part of the navigation satellite COSMOS 1861. They are a continuation of the "Radio" series begun in 1978 with RS-1 and RS-2.

Telemetry—Data transmitted by the satellite describing the health of the onboard systems. The format can be CW, RTTY, ASCII, PSK, or even synthesized voice.

Transponder—A linear "repeater" on a satellite that retransmits signals from one band to another. For example: An RS Mode "A" transponder takes a 40 kHz portion of two meters and translates it to a 40 KHz portion of 10 meters.

TVRO—TeleVision Receive Only. Television from space using microwave frequencies. Great fun to watch!

U-O-9—UoSAT-OSCAR-9. Built by hams at the University of Surrey in England, this low-orbit educational satellite transmits telemetry on many frequencies with a primary downlink on two meter FM. Launched in 1981, it is the oldest fully-functional hamsat.

U-O-11—UoSAT-OSCAR-11. The second University of Surrey hamsat was designed, built, and launched in six months. Launched in 1984, this hamsat continues the tradition of U-O-9 with several enhancements.

Uplink—The earth-to-space signals sent to a satellite.

QRM

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73 AMATEUR RADIO

MAY 1989 Issue # 344

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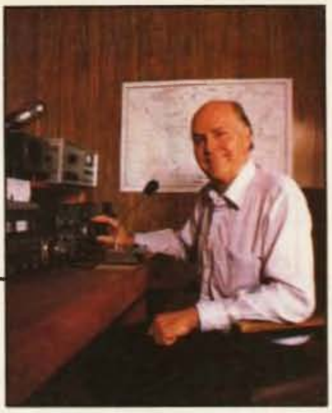
FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

Cover Photo:
Keith Berglund WB5ZDP field testing his home-brew Mode-L dish antenna. (Photo by WB5ZDP.)

Number 2 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



Legacy

As I look over the ominously growing Silent Keys list every month, often up to a full page these days, checking off old friends, I wonder what legacy all these hams have left to show for their existence. They've used our bands and enjoyed them, but what have they done in return?

Many that I have known well have contributed much to amateur radio. Most are like Bill Bennett W7PHO, who was commemorated at Dayton ... after his death, naturally. Recently we lost Bill Hoisington K1CLL, who helped a whole generation of hams enjoy home building with his many articles in *73*. He took us from 160 meters up through 2,300 MHz with stuff any of us could build on our kitchen table—and with easy-to-get inexpensive parts. And that even included making the needed test equipment.

Bandel Linn (Pappy) K4PP entertained us with wonderfully creative, professionally drawn ham cartoons for over thirty years. Fortunately we had a bunch still in stock when Pappy had a stroke, so we were able to continue them in *73*.

No one who ever knew Sam Harris W1FZJ will ever forget him. In addition to being a major power behind ham moonbounce experimenting, he also developed the first parametric amplifier.

I've written about these chaps before, but I wanted you to remember them so you could think in terms of what legacy you will leave behind when you get that final mention in *QST*. Will you be remembered for anything? Or are you merely going to be one tiny increment in the number of hams who died in a particular year?

Will your going be lamented? Will you go knowing you helped amateur radio in some way—paid your dues? Or will you be remembered for your repeater jamming? The Colvins have given us hundreds of thousands of rare DX contacts over the last 30 years, while another well-known DXer lied and cheated, the epitome of the ugly American. He used fake calls, forged documents, even operated over 10,000 miles from his stated location!

Maybe being an all-time scoundrel is something—perhaps better than being a nothing. Ask any old-timers about W2OY, who was nationally known for his endless jamming and bad-mouthing of early SSB pioneers. Or Max Myers W2BIB, who jammed medical and State Department traffic from Africa. How about you? Have you ever been the president of your radio club and made it really work? How many new hams have you helped get into the hobby? How many service nets have you helped? How many times have you helped with phone patch traffic? How many articles have you contributed to the ham magazines? What pioneering have you done?

You don't even have to be an inventor or engineer to help a new technology get going. I got started in publishing when I discovered radioteletype back in 1948. Wow! I built and experimented and then built more. By 1951 I was desperate to find out what everyone else in RTTY was doing, so I started a newsletter. That quickly became a small magazine—Amateur Radio Frontiers—and that led to a RTTY column in *CQ*—which led to my becoming the editor.

I got involved with pioneering even earlier. When Jack Babkes W2GDG started experimenting with narrowband FM in 1946, I quickly built an NFM modulator into my Meissner Signal Shifter and turned off my 500 Watt modulator. At that time NFM was consigned to the top half of the 20m phone band, 14,250–14,300. Since virtually all phone was AM, the DX ops rarely ever operated in the kilowatt-packed, QRM-filled American phone band. Most of 'em operated below 14,200 and then listened from 14,200 on up for calls. Only a few ventured into the seldom-used 14,300–14,350 DX band, so DX contacts were hard to come by for us NFM pioneers.

If the receiver manufacturers had gone to the trouble of building in NFM detectors, we'd have expanded faster. You could copy the FM with an AM detector, but QRM from AM signals was serious. By 1957 the SSB handwriting was on the wall, so NFM moved up to the VHF bands, where it's the rule today.

If you're an engineer, technician, or scientist, you may be interested in working with the incredible potential of digital communications. If you're mainly a rag-chewer, you could do worse than get busy on packet radio and then get set up for satellite work.

Alas, I've known hundreds of hams who have passed on without having contributed anything whatever to amateur radio or the world. It's a pity to have such a powerful tool right there in your hands and then never think to really use it.

What have you done? Have you

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock, NH 03449, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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QRX . . .

EDITED BY BRYAN HASTINGS NS1B

Goldwater Endorses No-Code!

One of Amateur Radio's elder statesmen, Barry Goldwater K7UGA, recently came out in favor of establishing a no-code amateur radio license. "I think we can swell our ranks by at least 200,000 if we just allow young would-be amateurs to come in as licensed amateurs without having gone through the process of learning Morse Code!" Senator Goldwater made this comment among many on the subject in a videotaped interview record at his Scottsdale Arizona ranch on Saturday February 25, to newsman Roy Neal K6DUE, producer Frosty Oden N6ENV, and Newsline Radio's Bill Pasternak WA6ITF.

Look for the complete story on this announcement in an upcoming "Looking West" column.

Well Done, Andy

The staff of *73 Magazine* extends their thanks to Andy MacAllister WA5ZIB for coordinating the editorial material for this issue. Those who think this is an easy job have no idea of the vast amounts of time one spends in bookkeeping and follow-up. Even through the more drudge-filled moments, Andy never lost his cheerfulness and enthusiasm—and we dare say he was key to putting together one of the finest issues on hamsats to appear in print.

Home-brew Contest Deadline

You haven't yet gotten around to writing up your home-brew project to submit to our *Home-brew IV* contest? Now you have a reprieve—we have moved forward the deadline for article submissions for this contest by two months. Please note that the new deadline is July 1, 1989. (See announcement in box.) Ham fame and fortune still await you—but not much longer!

18 MHz/ 17 Meters

The FCC has opened the 18 MHz band for amateur operation. Stations with General, Advanced, or Extra-Class operations were allowed access to the 18 MHz band as of 0001 UTC 31 January 1989—1 minute after 7 pm EST Monday, 30 January 1989. A1A emissions are allowed in the whole band from 18.068 to 18.168 MHz. Digital emission F1B, for direct printing, telemetry, telecommand, and computer communications, is permitted below 18.110 MHz; and analog emissions, such as FAX, SSTV, and phone, may be used on 18.110 MHz and up. Maximum power limit is 1500 Watts, but amateur operations must not cause harmful interference to US Government fixed service operations. The authorization is contained in a report and order in PR Docket 88-467. Under its terms and those of WARC-79, the band goes exclusively to the Amateur Radio Service on 1 July 1989.

Suspend and Revoke

The FCC has acted in last year's Puerto Rico amateur examination fraud case by revoking the licenses of six hams and suspending the licenses of three others for six months. Losing their tickets are NP4H, KP4KB, WP4FOF, WP4FOG, NP4E, and NP4ZM. It has also been learned that WP4FOF and WP4FOG were 9 and 12 year old children when the phony exams were given. The six month suspensions went to WP4U, KP4FW, and KP4IN. Two other hams, NP4ZN and WP4GAW, returned their licenses to the FCC for cancellation to avoid getting involved in the investigation.

Canada: 220 MHz Under Siege

The entire 1-¼ meter band is now under siege in Canada. According to a bulletin from the Canadian Amateur Radio Federation, the Ontario Ministry of Government Services wants 220–225 MHz withdrawn from amateur service across Canada and reassigned for exclusive government use. This threat to the entire 1-¼ meter band is one of the biggest ever faced by Canadian amateurs.

It's not only the government, however, that's going after it. Golden West Broadcasting of Manitoba wants the band made available for stereo and monaural point-to-point broadcast remote pick-up use. The Lapp Hancock Company has filed for it to become another personal and business radio band. Radio Atlantic noted that the 220 to 225 MHz band is lightly loaded in Canada and suggests reducing it by two MHz and implementing a personal communications service. It's the stand, however, of the very powerful Canadian Electrical and Electronic Manufacturers Association that could cause the real problem for amateurs on both sides of the border. They have taken note of the re-evaluation taken by the American FCC and say that the Canadian government should consider joint implementation of any new services between 220 and 225 MHz with the United States! If this does not occur and Canada proceeds on its own, it will mean that another line-A protection zone will have to be established, one that will bar American hams in the northern tier of the United States from using the band.

Communications Canada is expected to issue a spectrum utilization study on the future use of all bands from 30 to 890 MHz during the summer.

AF Doomsday System

The Air Force quietly approved the final construction phase for a nuclear "doomsday" radio network. They concluded that the project can be ex-

$$ HOME-BREW IV $$

73 Magazine again invites all home-brewers to turn their hot solder into cold cash and prizes, and to get their name in print to boot. All projects have a chance to appear in the magazine, and we will handsomely reward the authors of the best of these.

Now for the bounty. Ramsey Electronics sweetened the pot from their line of frequency counters. First prize is $300, a 10-year subscription to *73*, and a CT-125 1.25 GHz frequency counter. Second prize is $150, a two-year sub, and a CT-90 600 MHz frequency counter. Third prize is $75, a two-year sub, and a CT-70 525 MHz frequency counter. All this is in addition to the payment every author receives for publishing in *73*.

Contest Rules

1. Entries must be received by 1 July 1989.
2. To enter, write an article describing your best home-brew construction project and submit it to *73*. If you've never written for *73*, send an SASE for a copy of our Writer's Guide, or download it from CompuServe (Hamnet forum, Library Ø., filename "73WRIT"). *Be sure to state on the submission that it is for the Home-brew IV contest.*
3. Here's the real challenge: The total cost of your project must be under $73, even if all the parts were bought new. Be sure to include a detailed parts list with prices and sources.
4. Our technical staff will evaluate each project on the basis of originality, usefulness, reproducibility, economy of design, and clarity of presentation. The decision of the judges is final.
5. All projects must be original. That is, they must not be published elsewhere. There is no limit to the number of projects you may enter.
6. All purchased articles become the property of *73 Magazine*.
8. Mail your entries to: *73 Magazine*
   WGE Center
   Forest Rd.
   Hancock NH 03449
   Attn: Home-Brew IV

QRX . . .

panded without harming the environment.

The decision to expand the so-called GWEN network of radio relay towers across the nation was made by Air Force Deputy Assistant Secretary James F. Boatright, said Kevin Gilmartin, a spokesman for the Air Force Electronic Systems Division at Hanscom Air Force Base in Massachusetts.

Approval of the final construction phase means the GWEN network ultimately will grow from 56 radio towers linking 38 terminals at military bases to 96 towers linking 49 terminals, the spokesman said.

GWEN, an acronym for Ground Wave Emergency Network, is a system of low-powered radio antennas and transmitters designed to ensure adequate communications links for US military forces following a nuclear attack. The Air Force says the network is needed to ensure that the President can give launch orders to Strategic Air Command bombers. The service aims to complete the expanded system by January 1992.

A typical GWEN station consists of a thin, 300-foot tower and three small shelters surrounded by a fence. The shelters house electronic equipment and an emergency generator and fuel. The stations normally require a 700 square foot parcel of land. The output of a GWEN station is less than 2,000 Watts.

The Air Force currently is completing construction of what it calls the "thin line" system of 56 GWEN towers. Fifty of those 56 towers are already operating, receiving, and relaying brief test messages every 20 minutes.

The initial system construction sparked public controversy, with citizens' groups in Massachusetts, Oregon, Pennsylvania, and California banding together to fight GWEN on the grounds the towers increase the likelihood of their towns becoming nuclear targets. The Air Force repeatedly dismissed those arguments, asserting that the isolated towers were not worth that type of targeting attention by the Soviet Union.

Don't Touch That Dial!

Kevin Mitnick N6NHG is back in the news. This computer-hacking ham pleaded not guilty on Friday, February 3, to an expanded indictment alleging illegal use of MCI phone codes. Kevin N6NHG of Panorama City, California, is also charged with infiltrating computer systems in the United States and England.

Mitnick remains housed at the Metropolitan Detention Center in Los Angeles, where he is forbidden to dial a telephone. Judge Pfaelzer earlier declared that Mitnick posed a very great danger to the community, and ordered him held away from direct personal telephone access and without bail shortly after his arrest.

Farscholar

The Foundation for Amateur Radio plans to award thirty-two scholarships for the 1989–1990 academic year. Licensed amateurs may compete for these awards if they plan to pursue a full time course of studies beyond high school and are enrolled in or have been accepted to enrollment in an accredited university, college or technical school. Some of the scholarships require the holding of at least an FCC General Class license or equivalent. Request additional information and an application from: The Foundation For Amateur Radio, FAR Scholarships, 6903 Rhode Island Avenue, College Park MD, 20740.

New UHF Amp

A new amplifying device can operate at much higher frequencies, and with lower noise, than traditional field-effect transistors. The High Electron Mobility Transistor (HEMT) device uses a new material system. Pioneered and developed by Hughes, the HEMT device uses indium phosphide as a substrate with gallium indium arsenide and aluminum indium arsenide grown onto it, one layer at a time, using a process known as molecular beam epitaxy.

In a HEMT device, the semiconductor material containing the impurities is separated from the region of charge-carrying electrons, allowing the electrons to move much faster. Potential uses include ultra-high frequency communication systems, high-speed radar signal processing equipment, and high-power millimeter-wave circuits.

Truly Turbo

The British are working on a neural network computer, a device whose memory is organized in much the same way as a human brain. US DARPA has estimated that the human brain contains 10^{11} neurons, each having roughly 1000 dendrites, giving the brain a storage potential of 10^{14} interconnects. Since nerves fire at 100 Hz, the human brain thus has the potential to make 10^{16} interconnects per second. This is far, far greater than the CRAY XMP1-2 supercomputer with its potential of 50 x 10^6 interconnects per second. It's estimated that even a fly's brain can manage some 10^9 interconnects per second!

Tubes 'R' Us

There are still many of us who use equipment with tubes. Radio Shack can still order nearly any common tube. And they carry a guarantee.

The recent catalog from Star-Tonics lists the following tubes available "new, most boxed" at prices from $1.00 to $3.00: 5Y3, 6AK5, 6AU6A, 6B8G, 6BZ7, 6BZ8, 6C6, 6CB6, 6CL6, 6CW5, 6DZ7, 6F8G, 6GU5, 6JU8A, 12AH7, 12AT7, 12AU7, 12AX7, 12BY7.

For further info, write to them at *PO Box 683, McMinnville OR 97127.*

South Africa

Radio RSA, the Voice of South Africa, has extended its amateur radio news coverage. Amateur Radio Spectrum, presented by Hans van de Gronendaal ZS6AKV, is a program dedicated to amateur radio and satellite communications. North America can hear the program, given good propagation conditions, during the week from 14:52–15:00 UTC on 26,790 MHz, and on Sunday at 02:45–02:59 UTC on 11.760 MHz, 9.615 MHz, and 9.589 MHz. Reception reports are welcome and will be confirmed by QSL card. Send reports to *Radio RSA, PO Box 4559, Johannesburg, 2000, South Africa.*

USSR DX

Victor UA1MLI, who conducts a DX net for Arctic stations, Saturdays and Sundays at 0800 GMT on 14.150 MHz at 0800 GMT, invites stations worldwide to come on frequency and work some very rare DX for IOTA and various Soviet awards. KL7 stations are especially welcome.

Errata

Please take note of the following corrections in the March 1989 issue:

1) Heath HK-21 Review, p. 39, Figure 2. The black lead from the HK-21 is incorrectly shown wired to the tip of the miniature stereo plug. It should instead be wired to the plug shield (contact closest to the plug base).

2) QRX column, "Ham Radio Based Curriculum." Al Misunas' call is WB2RLO.

Thanks

To all who contributed to this month's QRX column. They are *Westlink, Indianapolis Star News, Worldradio, Modern Maturity Magazine*, ARRL, G8AUU, AMSAT-NA, Art Unwin KB9MZ, KD5RO, N6BVU, K5ZMS, G3VA, and NT2X. Keep your news items and photos rolling in to *73, Forest Rd., Hancock NH 03449, Attn: QRX*

Number 4 on your Feedback card

73 Review *by Gil Carman WA5NOM*

Silicon Ephemeris Tracker

Version 3.0 Satellite Tracking Program

Silicon Solutions, Inc.
P.O. Box 742546
Houston TX 77274-2546
Tel.: (713) 777-3057
Price Class: To Be Announced

Amateur radio pioneers established the Amateur Radio Satellite Corporation (AMSAT) to stimulate the development of knowledge, tools, and equipment which would bring satellite communications to the average amateur. Former AMSAT president, Tom Clark W3IWI, made perhaps the most important contribution, with his BASIC tracking program which was released in the late '70s.

This program used a very modest formulation. It included only the most significant factors which govern a satellite's orbital motion, and it produced results quite adequate for amateur use. Its universal design and minimum size made it easily adaptable to most of the small computers available in the newly emerging PC market. The amateur satellite enthusiast had finally found freedom from tedious pencil and paper tracking calculations, and he retired his OSCAR locator aids to a bottom desk drawer.

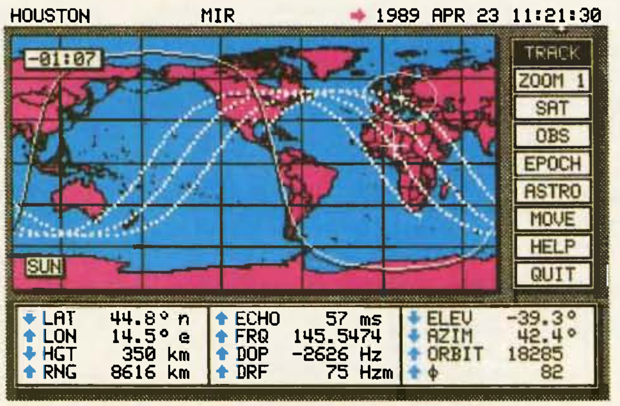

Figure 1. The world map with the satellite's current position and access area, or zero elevation contour.

Yesterday's Frills are Today's Basics

The rapid development in technology during the '80s has brought more affordable and powerful personal computing within the reach of the majority of hams. The most popular use of computers in the ham shack has long been satellite tracking; today, that distinction is perhaps being challenged by packet radio.

Most of the tracking software programs presently available from AMSAT have their roots in Tom Clark's original formulation, with variations in input and output features, depending on the capabilities of the operating systems and the hardware for which they are adapted. But the computer literate ham of modern times is no longer impressed by the slow and cumbersome software of past years. Color graphics, speed, and user friendly interfaces are now considered basic requirements.

Among the numerous offerings of tracking software available today, there is one which has been consistently considered by most amateur and commercial satellite users to be top of the line in abundance of features and ease of use. It is the GrafTrak II/Silicon Ephemeris package created by Joe Bijou WB5CCJ and Richard Allen W5SXD of Silicon Solutions, Inc.

Version 1.0 was first introduced in August 1985, following several years of development and verification. It is the first of a new generation of tracking software which uses the modern and powerful C programming language, and is not related to the IWI family. The version 2.0 upgrade in April 1987 added antenna and receiver control, as well as groundtrack plotting and automatic switching modes. It was difficult to imagine any additional tracking needs which version 2.0 would not fill, but the recently released version 3.0 offers many valuable enhancements to this already mature software.

System Requirements

GrafTrak II is the graphics-oriented program and Silicon Ephemeris is its tabular out-

Figure 2. If latitude and longitude inputs define the satellite's orientation, the orbit number will be replaced with the antenna off-pointing (squint) angle with respect to the observer. The arrows to the left of each parameter indicate whether its value is increasing or decreasing.

Figure 3. Press the "3" key to replace the track mode display with a three-dimensional perspective of the Earth as seen from the primary satellite.

put companion. The programs operate on the IBM PC, XT, AT, PS/2, and compatibles. The 8087/80287 math co-processor was required for previous versions, but now it is optional. Version 3.0 software will use the co-processor, if available, for improved performance, but it will run (significantly slower) without it. Systems based on the 80386 processor will provide a reasonable execution speed without the substantial investment in the 80387; however, I recommend the co-processor for the XT and AT compatibles unless you are blessed with extreme patience.

The minimum RAM requirement is 384K bytes, but you need 640K to make use of all available features. The graphics output is IBM 320 X 200 medium resolution with all CGA or EGA video adapters. EGA provides a much larger color spectrum to choose from. A single high density drive or two 360K floppy drives are minimum requirements to run GrafTrak; however, a hard disk is faster and more convenient. Initial program loading time has been significantly reduced in Version 3.0. It takes nine seconds on my IBM XT compatible, compared to 45 seconds for Version 2.0.

An excellent commercial quality illustrated manual is provided with the programs. It describes in detail all modes of operation and shows sample output. However, after a few minutes of initial setup and familiarization, you will find most of the commands to be intuitive single keystrokes, and with the help menu instantly available with a press of the "H" key, you seldom need to refer to the manual.

Display Features

After the GrafTrak program and data have been loaded, the display will show the world map with the satellite's current position and access area, or zero elevation contour (see Figure 1). This contour represents the Earth's horizon as seen from the satellite, and all observers within it will have line of sight access. In Version 3.0, this contour is not limited to zero elevation, but may be set for larger values if low-grazing passes are not of interest.

For satellites with downward (nadir) pointing, high-gain antennas, this coverage circle may be chosen instead to show a region within a nadir angle field of view as seen from the satellite. For weather and mapping satellites with downward pointing cameras, a swath-angle field of view may be defined, which will show a great circle arc normal to the groundtrack, indicating image width. Latitude and longitude grid lines may be included on the map display, if desired.

The first satellite and observer in the data base is initially selected by default if they have not been designated with command line tokens. These tokens may be included after the data base file name, in the same manner as batch file parameters, to set up all modes and options for the desired configuration at start up. To avoid the DOS command line limit of 128 characters, or just for editing ease, these tokens may be read from an ASCII text file. The selected primary observer and satellite are indicated at the top of the display. The current date and time are shown in UTC, as determined by the DOS clock. If you keep your DOS clock in local time, you must define the number of hours to add in the file OFFSET.GMT.

The numerical information at the bottom shows all pertinent tracking parameters, including satellite latitude and longitude, height, range to the observer, echo time delay between an observer's uplink signal and the returned downlink, Doppler shift, drift rate, the Doppler corrected beacon frequency, elevation and azimuth as seen from the observer, orbit number, and phase angle (mean anomaly count). If the data base includes bahn latitude and longitude inputs defining the satellite's orientation, the orbit number will be replaced with the antenna off-pointing (squint) angle with respect to the observer (see Figure 2). An arrow to the left of each parameter indicates if its value is increasing or decreasing.

The initial display is in the real time track mode, with the map and numerical information updating once per second. The satellite's position is normally shown at the center of the screen with the world map scrolling in the background. The map may also be set to remain centered on a selected longitude, if desired, with the satellite moving instead (Figure 1). The display may be stepped forward or backward in time by simply using the cursor keys to move an arrow indicator to the date or time item to be changed, then bumping it up or down with the + or − keys, respectively. An Epoch mode is provided to allow faster selection of a specific date and time, with the map display inhibited until return to the track mode. You may freeze the display at any time or activate the automatic fast forward mode. You will see an arrow to the left of the date to remind you when the display is not at current time. The escape key will restore the current date and time.

Many Functions

You have a large number of commands for performing special functions, such as finding rise and set times, drawing groundtracks, displaying the daylight/darkness sun line, or switching to a new satellite or observer. You select most of these functions with a single key stroke. By pressing the "H" key, you can display the multi-page help menu of all commands. Three different zoom magnifications are available which you may select manually or invoke with the auto zoom mode. This mode will automatically choose the largest map magnification that will show both the satellite and observer locations on the screen at the same time.

```
Silicon Ephemeris          V3.00      Copyright (C) Silicon Solutions, Inc.

     Mode  0 = exit to Operating System

     Mode  1 = one observer to all satellites
     Mode  2 = all observers to one satellite
     Mode  3 - schedule for one observer to one satellite
     Mode  4 = window between two observers and one satellite
     Mode  5 = rise and set times for one satellite
     Mode  6 - time ordered alerts for all satellites
     Mode  7 = one observer to all satellites (astro)
     Mode  8 - all observers to one satellite (astro)
     Mode  9 = schedule for one observer to one satellite (astro)

     Mode 10 - detailed ephemeris for Sun/Moon
     Mode 11 = all observers to Sun/Moon
     Mode 12 - schedule for one observer to Moon
     Mode 13 = window between two observers and Moon
     Mode 15 = schedule for one observer to Sun
     Mode 18 = Sun/Satellite visibility

     Mode 20 = select a new database file

                          Enter mode (         1 ) : __________
```

Table 1. Silicon Ephemeris main processing modes.

Silicon Ephemeris V3.00 Copyright (C) Silicon Solutions, Inc.
observer(s): Houston object(s): all

Amateur Radio passes for Houston, April 23

date	object	beacon	rise	tca	set	elev	az
Sun 23Apr89	FO-12	435.7950	00:14:26	00:26:12	00:37	49	128
Sun 23Apr89	Oscar-9	145.8250	02:00:44	02:05:00	02:09	16	72
Sun 23Apr89	Oscar-11	145.8250	02:07:10	02:12:15	02:17	10	66
Sun 23Apr89	FO-12	435.7950	02:16:06	02:28:02	02:39	49	325
Sun 23Apr89	Oscar-9	145.8250	03:32:58	03:37:25	03:41	16	264
Sun 23Apr89	Oscar-11	145.8250	03:42:16	03:49:04	03:55	59	260
Sun 23Apr89	FO-12	435.7950	04:21:18	04:32:04	04:42	22	348
Sun 23Apr89	Oscar-11	145.8250	05:25:05	05:27:04	05:29	1	271
Sun 23Apr89	FO-12	435.7950	06:26:20	06:37:16	06:48	24	16
Sun 23Apr89	FO-12	435.7950	08:28:53	08:40:59	08:53	57	38
Sun 23Apr89	RS-10/11	29.4070	09:48:15	09:55:55	10:03	21	86
Sun 23Apr89	FO-12	435.7950	10:31:03	10:42:34	10:54	40	234
Sun 23Apr89	RS-10/11	29.4070	11:32:36	11:41:13	11:49	44	279
Sun 23Apr89	FO-12	435.7950	12:38:13	12:42:55	12:47	2	244
Sun 23Apr89	RS-10/11	29.4070	13:26:15	13:28:22	13:30	1	295
Sun 23Apr89	Oscar-9	145.8250	14:58:56	15:03:53	15:08	36	99
Sun 23Apr89	Oscar-11	145.8250	15:45:04	15:51:51	15:58	53	99
Sun 23Apr89	Oscar-9	145.8250	16:32:27	16:36:02	16:39	7	291
Sun 23Apr89	Oscar-11	145.8250	17:23:29	17:28:44	17:33	11	293
Sun 23Apr89	RS-10/11	29.4070	20:53:01	21:00:10	21:07	14	73
Sun 23Apr89	RS-10/11	29.4070	22:37:30	22:46:19	22:55	66	268
Sun 23Apr89	FO-12	435.7950	23:21:23	23:32:26	23:43	30	124

Sun 23Apr89 passes = 22

Table 2. Result of using Mode 6 selection from Table 1. The tracked birds are all LEOs (Low Earth Orbiters).

The auto-switch mode will determine which satellite has the nearest upcoming acquisition time, and select it as the primary object. While in the auto-switch mode, an audio alarm will sound every minute, starting at five minutes before the expected rise time of the selected satellite. A long warble sound announces the rise and set. This alarm feature helps prevent a pass from occurring unnoticed, and you may also activate it while tracking a single satellite. It will continue to track the selected satellite until the satellite sets. Then it will search for the next available satellite. Time from the current satellite's rising is also shown on the display during auto-switch mode.

Press the "3" key to replace the track mode display with a three-dimensional perspective of the Earth as seen from the primary satellite or celestial object being tracked (see Figure 3). This view may also be generated for any extraterrestrial observation point by specifying its latitude, longitude, and altitude relative to Earth.

Perhaps the most significant new enhancement in Version 3.0 is the alternate satellite display capability. Since the auto-switch selection of a high altitude satellite like OSCAR-13 can last for several hours, opportunities for others like FO-12 might go unnoticed if it were not for this feature. You may include coverage circles in the display for as many additional satellites as you desire, with each identified by its menu number (see Figure 2). This capability also greatly simplifies the rather complex task of determining multi-satellite crosslink opportunities. Two satellites are within mutual

Continued from page 14

line of sight when their horizon circles are overlapping.

Data Base Management

With GrafTrak II's editor, you can create and edit the data files. Each file contains information for as many as 16 satellites and 16 observer locations. The working data file is specified on the command line when the program is loaded, and you may change it later. You can create as many data files as you need. Using the editor, you may write out or read in individual satellites or observers to rearrange their order or to transfer data between files.

The input satellite orbital parameters are the standard NORAD mean Keplerian elements, which you may either enter manually or read in from an ASCII text file in the two-line format of the NASA prediction bulletins. You may load the editor and run it as a DOS gateway function from GrafTrak if you have at least 640 K of memory. GrafTrak will remain loaded during editing and retain all previously set modes.

Accurate Orbital Information

Accurate orbital information is the most important key to successful satellite tracking. Regularly updated elements are available from several dial-in bulletin boards and packet radio services. You may obtain data for the amateur radio and weather satellites from the weekly AMSAT bulletins at the WD0GML BBS in St. Louis at (314) 447-3003. Silicon Solutions is developing a processor which will automatically update the GrafTrak data files from the AMSAT bulletin format. The Celestial RCP/M BBS operated by Tom Kelso in Fairborn, Ohio, (513) 427-0674, maintains up-to-date two-line elements for about 60 of the most commonly requested satellites.

I use a batch process of my own design which, with the press of a single menu key, automatically dials the bulletin board, downloads the current file of two-line elements, hangs up, extracts the satellites I use, and reads them into the GrafTrak data file by preloading the keyboard buffer with the required editor keystrokes. Those who have not yet joined the world of digital communications may obtain the NASA prediction bulletins by mail, free of charge, from *The NASA Goddard Space Flight Center, Code 513, Greenbelt MD 20771.*

In addition to the Keplerian elements, a beacon frequency may also be specified for each satellite. The tracking display will output the Doppler shift and drift rate resulting from the satellite's motion relative to the observer. For two-way operation through satellites that have inverting transponders, like OSCAR-13, I prefer to input the beacon frequency as the downlink minus the uplink frequency at the passband center. The Doppler output will then be the correction which you add to the nominal transponder sum.

For example, if you wish to zero beat a station, and the Doppler shows 2.1 kHz, simply transmit 2.1 kHz above the normal uplink frequency. This will put you very near zero beat without the typical "VFO sweeping" to find your downlink. This method will result in a meaningless frequency display (Figure 2), but I have found the two-way Doppler information more useful. If you want only the one-way Doppler, input the nominal beacon frequency and the display will show the Doppler-corrected downlink.

Automated Rotor and Receiver Control

One of the best features is the antenna rotor control, or auto-tracking capability, which provides serial port output of azimuth and elevation pointing commands to an external ARRL compatible interface unit (*QST*, September 1986, p. 40). Automatic receiver frequency control for downlink Doppler drift compensation is also included for external Yaesu FRG-9600 compatible units. These modes provide hands-off computer antenna pointing, greatly easing the operating task, especially for low-altitude satellites like FO-12.

When the antenna control is active, the elevation and azimuth displays are modified to show both the desired pointing angles and the current rotor positions as read from the interface (Figure 2).

Antenna and receiver controls were first available in version 2.0, but some enhancements have been made in version 3.0, such as a FLIP option to avoid azimuth rotor hard-stop reversals during a pass. This uses the inverse tracking technique (when required) of pointing the azimuth directly opposite the satellite's direction and redefining the horizon at an elevation of 180 degrees. Of course, your elevation rotor and interface unit must be capable of 180 degrees of rotation to use this feature. Antenna pointing is normally disabled when the display is not at current time because the satellite will not be there, but you may activate it for testing.

An optional software driver is available for the Kenpro KR-010 interface, and assembly source code is provided for a memory resident station control program which may be customized to meet your own interface needs. In addition to the kit offering from A&A Engineering, which you will find in the *QST* article, compatible units are also available from *Mirage Communications Equipment, Inc., PO Box 1000, Morgan Hill CA 95037* and *L.L. Grace Communications Products, 41 Acadia Drive, Voorhees NJ 08043.*

Astronomical Tracking Modes

The tracking calculations are not limited to manmade Earth orbiting satellites. By selecting the astronomical mode, tracking information will be displayed for either the Sun, Moon, or a Star. There is no built-in menu of stars or planets to choose from, but you may input the inertial right ascension and declination of a celestial object. All satellite functions, such as groundtrack plotting, rise and set searches, three-dimensional Earth views, and even antenna pointing for EME operations are available in the astronomical mode.

The position and pointing calculations in astronomical mode are accurate to better than one arc minute for any epoch within 2000 years of the current date. The time-keeping functions are performed in true Julian date, eliminating the need for annual sidereal time updates and leap year difficulties which have plagued other tracking software.

If you have an interest in visual sightings of satellites, the GrafTrak/Silicon Ephemeris combination is definitely the software for you. You can make a fast check for visual opportunities by selecting one hour after sunset (or, for morning passes, before sunrise) and stepping the time forward in one-day increments until the groundtrack "walks" its way over to your location. The Sun/Satellite visibility mode of Silicon Ephemeris provides detailed pointing and lighting tables for all periods when the satellite is in sunlight above your horizon, with the Sun elevation below the desired value.

The passes with best visibility usually occur when the sun is about 12 degrees below the horizon; however, the brighter satellites, like *Mir* and the space shuttle, can be seen in twilight under favorable conditions.

You can save the screen images on disk as picture files and recall them later. A utility program called SHOW can load several of these files into RAM and display them consecutively in a repeating animation sequence. You may set the speed of this animation as desired. It's especially effective in creating demonstrations, such as a "satellite's-eye view" of the Earth in orbit, a perpetually spinning Earth as seen from the moon, or the annual figure eight analemma of the Earth's motion as seen from the sun.

Tracking Table Printouts

Silicon Ephemeris is the tabular output companion to GrafTrak. It includes 18 different modes of tracking data calculations which will satisfy the most demanding satellite enthusiast or EME operator. See Table 1 which shows the main menu of processing modes. The multi-satellite and multi-observer modes are very useful as real-time screen displays of mutual access geometry, but they may also be used to search for an event or verify an event at a desired date or time. The schedule and window modes fill the need for long-range predictions when printed output is required for planning future operating times.

Use Modes 4 or 13 for communication opportunities, when two observers will have simultaneous access to a satellite, or for EME (moonbounce) operation. I have used Mode 6 most often, since acquisition times for all low-altitude satellites in the data base file are output in the order in which they occur (see Table 2), eliminating the need to cross reference several printouts. This way you can be sure not to miss an opportunity. However, as a result of its fast analytical formulation, this mode will not include the high elliptical orbit satellites, like OSCARs 10 and 13. You may obtain tabular tracking data for Phase 3 orbits, which may have unusual groundtrack geometry, with Modes 3 and 5. These are slower, recursive search modes.

You're not likely to find a more complete satellite tracking system anywhere! 73

Inexpensive Mode-L Dish Antenna

Pay little and gain much.

by Keith Berglund WB5ZDP

With Mode-L now a reality on AMSAT OSCAR-13, my thoughts turn towards which antenna I should use. There are a few commercially available, but none of them are circularly polarized, and all are more expensive than I would have liked. A $125 price tag is not expensive to some hams but, on the other hand, if you have access to a drill press, a hacksaw, and $30, you can walk into your local hardware store and end up with a 23.5 dBi gain antenna that will give you a bodacious signal through the bird.

How Big?

In theory, a parabolic dish is pretty simple. Merely take a low gain feed antenna at the focal point, point it at the parabolic reflector, and Blammo! The RF energy is focused into a tight, high gain beam. This antenna is no exception, so the project can be divided into two parts: the dish and the feed antenna.

You must first determine how much gain you would like out of your antenna. As you would expect, gain equals size. The bigger the dish, the bigger the gain. A simple formula that relates these factors is: $G(dBi) = 7.5 + 20 \text{ Log } d + 20 \text{ Log } F$, where d = the diameter of the dish in feet, and F = the frequency in GHz. So, for example, the gain of a five foot dish at 1269 MHz would be $7.5 + 13.98 + 2.07 = 23.55$ dBi.

Next, you must determine the shape of the dish. A graph of the dish can be determined by using the formula: $Y = X^2/(4*f)$, where Y = the Y coordinate, X = the X coordinate, and f = the focal length in inches (distance from dish origin to the feed antenna).

I used a simple hand calculator to plot X as a function of Y for X values from zero to 30 inches in one-inch increments. Thus, 30 inches corresponds to half of the parabolic shape of a 60-inch (5-foot) dish. I chose an "f" of 24 inches, which corresponds to a focal-length-to-diameter ratio of 0.4 (60/24). The 0.4 ratio is a good choice for the feed system that I selected (more on that later) and is easy to construct.

Construction

Enough about theory. How do you build it cheaply?

The first thing to do is to take the points calculated above and turn them into something tangible. Get a piece of old 4'x 2' ½-inch plywood (or equivalent), and mark the full-scale X and Y coordinates on it with a black marker pen. At zero, and then at increments of one inch, drive nails into the curve. After 30 points, and 30 nails, you will have a rugged template to work with.

Go to your local hardware store and get some ½-inch electrical conduit. It's cheap, available, and bendable. A 10-foot piece costs less than three dollars. You will need three of these pieces to make the "spokes" of the dish. Use an ordinary hacksaw to cut eight 32-inch spokes. Then, using a bench vise as a conduit bender, carefully bend the pieces to conform to the wooden template, generating eight spokes. If you have access to a real conduit bender, by all means use it. Be careful not to bend the conduit too much as it will permanently kink. At this point, drill two ¼-inch holes completely through the conduit at 1 inch and 2 inches from zero to accommodate mounting.

The center hub that everything attaches to consists of two pieces of ⅛-inch aluminum sheet cut into an octagon shape and drilled as shown in Figure 1. Every 45 degrees, drill two holes for each "spoke". This hole pattern also allows for a 1-inch plumbing floor flange to be mounted to the bottom of the bottom plate, and a ¾-inch floor flange to be mounted to the top of the top plate. The 1-inch flange may have to be redrilled to accommodate the hole pattern of the hub, but this is can be done easily using a drill press. These flanges are designed to accommodate a piece of 1-inch pipe to act as a mounting pole for the dish, and a ¾-inch piece of pipe to accommodate the feed antenna (more on this later).

After assembling the hub and spokes as shown in Figure 2, you'll have a five-foot, eight-legged spider!

Adding The Screen Wire

While you're at the hardware store, buy 20 feet of ordinary metal screen. Before the screen wire can be added, it must have something to attach to. Drill a ⅛-inch hole through the end of each spoke so that a piece of 16 AWG wire can be strung around the outer perimeter of the dish. The two ends of the wire are held together and tightened by a small screen door turnbuckle (see Figure 3). Next, on the inside of the dish, starting about ¼ inch in from the outer perimeter, drill a ⅛-inch hole every four inches along each leg.

Continued on page 91

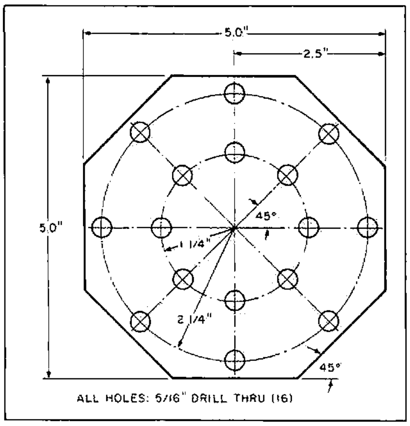

Figure 1. Center hub of the Mode-L antenna. It consists of two pieces of ⅛-inch aluminum sheet cut into an octagon shape and drilled.

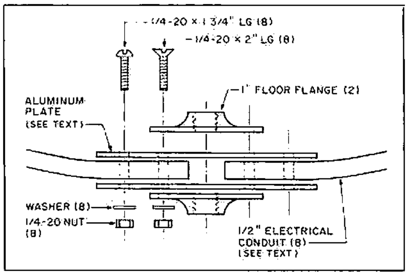

Figure 2. Assembling the spokes on the antenna hub.

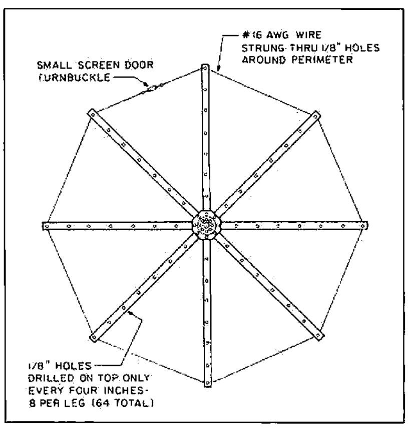

Figure 3. Frame of the Mode-L antenna.

Decoding OSCAR Telemetry—Part I

Learn all about the state of the birds.

by James R. Miller G3RUH

Tune to 145.8-146.0 MHz SSB at some hour any day, and chances are you'll hear the familiar sound of hams enjoying an OSCAR-13 contact. But search around on 145.812 MHz SSB, and you'll hear something different—a rhythmic purring sound. That's OSCAR telemetry, the satellite's signals telling us just how things are up there.

All satellites broadcast telemetry. Some do nothing else. There are four sending data now, and at least four more in the pipeline. This telemetry data is available for anyone to enjoy—now! All you need is a little electronics, a decoder to turn that whirring noise into digital form, and a terminal, as with packet radio, to display it.

And that's when the fun begins. You can read the mail, download the bulletins, keep up-to-date on OSCAR-13 operations, decode the numerical data and learn about the space environment, study a spacecraft's health, or like me, do all of these!

In the last few years I've supplied over 2000 decoder PCBs to hams to help them unlock the secrets of OSCAR telemetry. Maybe you'll be next!

In Part I, I focus on three satellites: OSCAR-9 (UoSAT-1), OSCAR-11 (UoSAT-2), and OSCAR-13 (P3C). Look for telemetry info, Fuji-OSCAR-12 (UoSAT-D), and the four microsats in Part II, to appear in the June '89 issue of *73*.

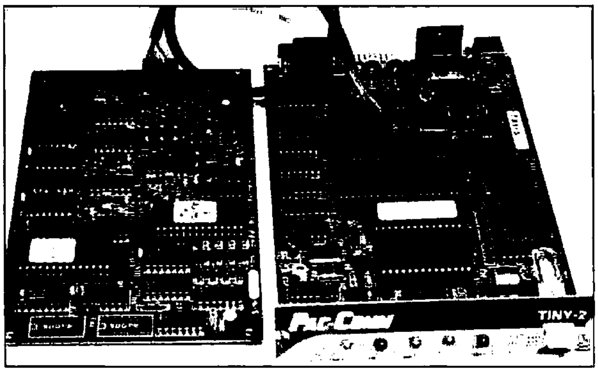

Photo A. 9600 baud modem for packet radio and UoSAT-D linked to the modem disconnect header of Pac-Comm's Tiny-2 TNC. One EPROM contains data for a "finite impulse response" digital filter that precisely shapes the transmitted audio waveform for minimum bandwidth. The other is part of a high resolution digital phase-locked loop for clock recovery. EPROMS are supplied with the PCB.

The Telemetry Decoder

Surprisingly, you can decode some telemetry with very simple equipment. UoSAT sends very strong signals you can receive on a regular FM HT several times a day at 145.825 MHz. To turn the audio you hear into an RS-232 digital stream, all you need is a simple decoder circuit consisting of two one-shot monostables and a flip-flop. The display system might be a 1200 baud printer or 1200 baud computer terminal (VDU).

But simple decoders only work properly on noise-free signals, and it wouldn't be long before you'd want to improve your decoder. A proper error-resilient UoSAT decoder would be a natural upgrade, as would a gain antenna for stronger signals.

Once you start acquiring telemetry data, you're soon faced with the fascinating problem of what to do with it all. The computer comes into its own as a means of storage, retrieval, processing, and presentation. An audio cassette recorder is invaluable when you want to re-examine raw audio signal after the satellite has passed.

Satellite Overview

Because the cost per Watt of spacecraft power is enormous, satellites usually transmit with only just enough power for the job. They expect ground stations to provide good "ears" and smart demodulators.

Such is the case with OSCAR-13. To acquire and decode its telemetry, you need an SSB receiver (2 meter or 70 cm) and a rotatable beam antenna, preferably with elevation control. If the coax feeder is long and loses more than about 3 dB of signal, you'll need a masthead preamplifier. A specific "AO-13 Data Demodulator" extracts the digital data. Some of this can be dumped to a printer or VDU, but in practice, the computer will need to read, process, and display it first. Hardware and software is readily available for several machines. For the basic user, OSCAR-13 also sends two short Morse code bulletins and ten minutes of 50 baud RTTY every hour.

Fuji-OSCAR-12 carried the first spaceborne packet radio mailbox for general use. It sends telemetry in AX.25 packet format. You will need a 70 cm SSB receiver, gain antenna with steering, an AX.25 packet radio TNC, and an FO-12 PSK modem. This will let you read down-coming mail and telemetry values. The data rate is 1200 baud. To access the mailbox, you need an FM transmitter on 2 meters. The modem does the uplink digital-to-audio conversion. When not in mailbox mode, FO-12 sends its telemetry in CW.

Two of the new MicroSats, which AMSAT North America is preparing for a late 1989 launch, will carry AX.25 packet radio mailbox facilities. The uplink and downlink formats are identical to those of FO-12. Strong received signals on 70 cm are planned. An omni-directional antenna may be satisfactory. A third MicroSat will carry a TV camera and transmit its images digitally in AX.25 packet format.

UoSAT-D will be launched with the MicroSats, making up a six-satellite mission for the Ariane rocket. UoSAT-D will carry a Packet Communication Experiment (PCE) for general use, and transmit its packet traffic and telemetry in AX.25 protocol frames on 70 cm FM. The UoSAT-D data rate is 9.6K bits/s. You would need a 9600 baud modem with the TNC.

UoSAT

General: There are two UoSATs, UoSAT-1/OSCAR-9 and UoSAT-2/OSCAR-11. They are in similar orbits, with periods of 93.6 and 98.5 minutes. Due to their orbits, the satellites conveniently appear around the same time each day. For example, UoSAT-2 goes overhead southbound at about 1000 local time each day, and Northbound at about 2100 (± 45 minutes). A typical pass lasts about 12 minutes. Ideal for schools, for example, or for anyone who wants an organized life!

Both transmit very strong signals on 145.825 MHz FM, and sometimes on 435.025 MHz FM. You can hear them on a 2 meter HT.

Data Transmitted: UoSAT-2's data transmission follows a regular weekly pattern and consists of plain-text bulletins of interest to all satellite users, telemetry data, and information related to the special packet radio "data communications experiment" (DCE). The telemetry is of two kinds; either 70 quantities sent repeatedly every 5 seconds, or dwell telemetry. That's one or two specific quantities gathered up over a whole orbit and sent in one long burst.

Figure 1 shows an example of a plain-text bulletin drawn at random from my log disc. These bulletins are typically several pages long. The news is gathered from all over the

world, and it's the most up-to-date source of amateur satellite information available anywhere.

Now see Figure 2. The first line shows the date: 1989 Jan 26, Thursday, at 1028:08 UTC. Then follow 70 data groups are in the format CCddd, where CC is the channel number, 00 to 69, and ddd is the value. For example, "37431" means channel 37 has value 431. You can now look up the meaning of channel 37 from the published table (see "Reading" at the end of this article), and find that it's the 145 MHz Beacon Temperature, and converts as Temp = 0.2 x (480 - N). Simply plug in N = 431 to discover that the temperature is 9.8 degrees C.

Of course, you wouldn't want to go through that exercise too often, but I think you'd agree that a computer program to dissect the table and do the calculations is quite straightforward, fun, and an ideal project for hams and college students alike!

Telemetry Format: UoSAT-2 sends data in normal 11- or 12-bit serial ASCII code; one start bit, seven data, even parity, and two or three stop bits. It signals bits by using two tones, or exactly two cycles of 2400 Hz for a data "1" (stop/idle), and exactly one cycle of 1200 Hz for a data "0" (start). The sine wave tones zero-crossings are synchronized with the data transitions. The tones are transmitted as FM on the 145.825 MHz carrier. (UoSAT-1 has the tones reversed).

Telemetry Demodulation: The simple signaling scheme suggests that a decoder based on timing zero-crossings would be easy to implement, and I have seen at least six designs. While they would get you going, they are very prone to errors caused by noise spikes. A much better method is to exploit the information carried by two synchronous tones in a device called a "matched filter decoder."

The G3RUH UoSAT Decoder has been available since 1983, and about 800 are in use by hams, schools, colleges, and at the UoSAT Spacecraft Control Station itself at the University of Surrey, Guildford, England.

Essentially, the decoder compares incoming audio with locally generated 1200 and 2400 Hz replica tones. The best similarity determines whether the bit is a "1" or a "0." Resilience to noise comes about because noise is completely unlike the tones, or "unmatched."

The decoder then outputs ASCII data at RS-232 voltage levels that any terminal device or program can read.

Decoder Specifications:

Input—Typically 50 mV to 5V RMS audio from an FM receiver.

Output—The 1200 baud serial data stream is output in three formats: 1) RS-232c level, 2) regenerated two-tone audio for tape recording, 3) 12V CMOS level plus 1200 Hz clock.

Controls—Input invert switch; UoSAT-½ switch; lock meter.

Set-up—Two preset pots: PLL frequency and ½ voltage supply.

Power/PCB—12V @ 15 mA. Single-sided PCB, 160 x 100 mm. Eight CMOS chips, one op amp. 19 resistors, 12 capacitors.

Availability—You may obtain PCB from G3RUH, AMSAT-UK (12 pounds airmail), and AMSAT-VK, or order it via Project OSCAR. AMSAT-NA stocks no satellite products, though this should change soon. Phone and check. All addresses and phone numbers are at the end of this article.

Associated Equipment: You can use any 2 meter FM radio to receive UoSAT on 145.825 MHz. You can take audio direct from the external speaker socket. Some receivers will have a separate AF O/P socket on the rear panel that bypasses the volume control. The antenna can range from the "rubber duckie" to a fully steerable beam; results will be in direct proportion to signal strength. With a beam antenna without elevation control, you can follow passes that don't rise more than about 30 degrees. A "turnstile" (crossed dipole) is a very effective, simple, fixed omnidirectional antenna, especially for overhead passes. You can display the data on any 1200 baud serial device, such as a VDU, printer, or computer terminal. If you operate packet radio, you already have a suitable terminal.

"All satellites broadcast telemetry."

Reading: Probably more has been written about UoSAT than any other amateur spacecraft, and the list below is just a selection. The UoSAT booklet will appeal to Novices and old-timers alike, and has the full telemetry specifications. N5AHD's article shows what you can do when you're really hooked! The UoSAT program papers by Martin Sweeting and his team of engineers range from the very general (no math) to the highly scientific, and I highly recommend them for a full understanding of the practical realities of every aspect of spacecraft design and operations.

Miller J.R., G3RUH, "Data Decoder for UoSAT," *Wireless World,* (UK), May 1983, pp. 28-33.

"UoSAT Spacecraft Data Booklet," UoSat Unit, University of Surrey, Guildford, England, May 1986. 41 pages. (Obtain from AMSAT-UK, 6 pounds airmail).

Davidoff M.R., K2UBC, *The Satellite Experimenter's Handbook,* ARRL 1984, ISBN: 0-87259-004-6.

Diersing R.J., N5AHD, "Processing UoSat Whole-Orbit Telemetry Data," *Proceedings of the 4th Annual AMSAT Space Symposium,* pp. 55-76. ARRL 1986.

Sweeting M.N., G3YJO, et. al., "UoSAT—A Cost Effective Spacecraft Engineering Programme," *J. Inst. Electronic and Radio Engineers,* (UK), Supplement to Vol. 57 No. 5, Sept/Oct 1987, 120 pages, 14 articles. ISSN 0267-1689. (Obtain from AMSAT-UK, 10 pounds airmail).

OSCAR-13

General: OSCAR-13 is the latest voice/CW transponding satellite for hams, launched by Ariane rocket on 15 June, 1988. Its period is just under 12 hours, and its orbit is elliptical. Most of the time its distance from the Earth exceeds 35,000 km (22,000 miles), which means nearly half the Earth is in view for hours at a time, every day.

OSCAR-13 carries three transponders: Mode B (70 cm up, 2 meters down), Mode L (23 cm up, 70 cm down), and Mode S (70 cm up, 13 cm down).

Telemetry transmissions are associated with each mode. On 2 meters this is at 145.812 MHz, while on 70 cm it is 435.653 MHz. Occasionally these are changed to 145.985 or 435.677 MHz for a few minutes. Transmissions are continuous. On the hour and half hour, there are short CW bulletins; on the quarter hours, five minutes of 50 baud RTTY. The rest of the time, OSCAR-13 broadcasts telemetry data.

Data Transmitted: OSCAR-13 alternately sends two kinds of information: plain-text message bulletins and spacecraft numerical telemetry. It transmits data in 512 byte blocks, each block preceded by four synchronization bytes and followed by a two-byte check sum. Idle bytes space out the blocks. Plain-text uses ASCII codes.

A byte, comprised of eight bits, is transmitted serially at a rate of 400 bits/s. A block lasts 10.24 seconds. Blocks are separated by about 13.5 seconds. This rhythm is clearly discernible in the audio.

Figure 3 shows two typical message blocks. Note that the first letter of a block is a unique block identifier. Five text blocks use K, L, M, N, and Y, while telemetry data uses the letter Q.

Telemetry data (Q) blocks are hybrid. The first 256 bytes are plain-text, and identify the satellite. They also show the time, date, and certain command status flags. The second 256 bytes contain 128 bytes of data about the spacecraft's present operation, and 128 bytes of historic "snapshot" data. These data bytes sent voltages, currents, temperatures, navigation sensor, status flags, counters, timers, and so on. You can decode them with reference to the published calibration information. The computer's job is to present the data in real time.

Telemetry Format: I described the block format above. Now I'll recast the bits in a form familiar to packet radio users, NRZI. This means that a "1" is represented by a change in the bit stream (01 or 10), and a "0" by no change (00 or 11). Next, each bit is exclusive-ORed with the 400 Hz bit rate lock (Manchester coding). Finally, the transmitter carrier is modulated the same way as SSB is produced. Because the signal is binary, the net result is a 180 degree reversal of the carrier phase known as phase-shift keying (PSK).

Yes, it's complicated because it has to make maximum use of the precious spacecraft power. Only one Watt is transmitted, yet a 400 bits/s data rate at 40,000 km is

```
          UoSAT-OSCAR-11      Bulletin-060     23 Oct. 1986
          **************      ************     ************
                    UoSAT Spacecraft Control Centre,
                     University of Surrey, England.

 * Particle Wave Surveys Continue *
  The UO-11 particle/wave experiment and the Digital Store and Readout
 system have seen daily use during that last week.

 ** AMSAT PHASE-IV STUDY LAUNCHED **
  AMSAT-NA Engineering Vice President Jan King (W3GEY) recently completed
 a "Phase 4 Technical Study Plan", outlining the technical and operational
 choices that must be made as Amateur Satellite community looks for more
 advances satellite communications facilities.  The document addresses all
 of the engineering choices that effect selection between Molniya or
 geostationary orbits, and proposes that AMSAT Phase-IV devote itself to
 geostationary spacecraft.  Members of the technical study team have been
 looking at solutions to the problems that would be faced during the design
 and operation of a low-cost geostationary satellite.
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Figure 1. A plain-text bulletin drawn at random from the G3RUH log disc.

```
UOSAT-2              8901264102808
00510 01517 02188 03408 04052 05039 06026 07051 08045 09033
10403 11336 12000 13064 14148 15458 16241 17588 18646 19565
20124 21207 22660 23635 24001 25239 26192 27524 28469 29512
30519 31090 32291 33576 34000 35271 36320 37431 38473 39500
40765 41120 42633 43054 44167 45000 46000 47491 48491 49472
50607 51119 52682 53290 54892 55000 56000 57497 58492 59497
60828 615FD 6201F 63F24 64440 651C0 66601 67700 68000 69000
```

Figure 2. An example of an actual telemetry frame as a printer or VDU would show it.

```
M de DB2OS & G3RUH                                Update 1989 Jan 30
 ***    AO-13 TRANSPONDER SCHEDULE     (valid until March)   ***
   Mode-B    from  MA   3  until  MA 100    Attitude ALON / ALAT
   Mode-JL   from  MA 100  until  MA 150     Jan 30  178.8/ -1.4
   Mode-B    from  MA 150  until  MA 240     Feb 06  178.9/ -2.1
   OFF       from  MA 240  until  MA   3     Feb 13  179.0/ -2.8
         Attitude gives best pointing angle around apogee.
    Rate of change in ALON: 0.016 deg/day, ALAT: -0.1 deg/day.

N de VK5AGR 07Jan89 0030 utc QST: The OSCAR-13 Operations and
Technical Handbook produced by AMSAT-UK in collaboration with
AMSAT-DL is NOW available - Contact AMSAT-UK, Project OSCAR or
AMSAT-Australia for details.                       73  Graham

Peter DB2OS - Jan 30: Can you  please send tape of software to
check out IHU with 32K memory board - works OK with AO10
recovery software but not IPS-C2??  73 Graham.
```

Figure 3. Two typical message blocks. The first letter of a block is a unique block identifier. Five text blocks use K, L, M, N, and Y, while telemetry data uses the letter Q.

possible, error-free. Compare that with terrestrial RTTY or packet radio.

Telemetry Demodulation: Recovering the digital data from received audio is also complicated, similar to the encoding process just described, but in reverse. First the audio carrier (about 1500 Hz) is acquired and removed. Then the 400 Hz clock is acquired and removed. Next, the bits are detected in a "matched filter." Now the NRZI is unscrambled back to regular data.

A circuit searches for the synchronizing bytes, and when it finds them, 512 bytes are clocked out to a parallel port. They are also loaded into a serializer which operates at 1200 baud and provides a start/stop serial stream to an RS-232 port. The G3RUH OSCAR-10/13 PSK Data Demodulator provides all of the above functions and has been available since 1984. About 500 are in use at present.

Decoder Specifications:

Input—Typically 50 mV to 5V RMS audio from an SSB receiver.

Outputs—Three formats: 1) RS-232 level 1200 baud, 2) eight-bit parallel, 3) 400 bits/s raw data.

Controls—Tune Carrier, Tuning/Lock meter, Meter select.

Set-up—Three preset pots; two PLL frequency and ½ voltage supply.

Power/PCB—12V @ 30 mA. Double sided PCB plated through, 200 x 160 mm. 24 CMOS chips, one op amp. 23 resistors, 22 capacitors.

Availability—The PCB is available from AMSAT-UK (19 pounds airmail). You can also order it from AMSAT-VK and Project OSCAR. RadioKit sells PCB plus full kit of parts. AMSAT-NA stocks no satellite products, though this may change. Phone and check. All addresses and numbers are at the end of this article.

Associated Equipment: You must use a 2 meter or 70 cm SSB radio to receive OSCAR-13 on 145.812 or 435.653 MHz. Tuning rate should be 100 Hz/step or better. You can take audio direct from the external speaker socket. Some receivers will have a separate AF output socket on the rear panel that bypasses the volume control.

Receiving antennas must have at least 10 dB of gain, with little coaxial feeder loss unless there is a masthead preamplifier. Steering in azimuth is essential, and elevation is highly desirable if you wish to observe all passes.

It is possible to display the plain-text information on a VDU or 1200 baud terminal device. Problems arise with the data telemetry, though, because all codes from 0 to 255 will occur. These will invariably cause comic effects on the screen, such as clearing, inverse video, beeps, backspacing, foreign symbols, and in the case of printers, ejection of large amounts of blank paper.

Software: The only practical way to handle the telemetry data is with a computer, and the RS-232 decoder output ensures that most can be used. Software is available for several machines, notably the IBM PC, Commodore C-64, Acorn/BBC, Atari 800XL, Tandy TRS-80, Sinclair Spectrum, and possibly others. These programs are not at all complicated; most of their job is cosmetic, i.e., creating a tidy display! You can obtain IBM-PC and CBM-64 display programs from AMSAT-UK, AMSAT-VK, and Project OSCAR.

Reading: The *OSCAR-13 Handbook* contains a wealth of facts, figures, tips, and descriptions of the satellite systems. It explains the telemetry in fullest detail. Worldwide contributors. A G3RUH PSK Decoder article is supplied with the PCB.

OSCAR-13 Operations and Technical Handbook, AMSAT-UK, London E12 5EQ, England. 52 pages. (From AMSAT-UK 6 pounds airmail, AMSAT-VK, or Project OSCAR).

Miller J.R., G3RUH, "A PSK Telemetry Demodulator for OSCAR-10," *Ham Radio,* (USA). April 1985, pp. 50-62. Also published in *Wireless World* (UK), Oct/Nov 1984, *Radio Rivista,* (Italy) May/Jun 1984. 73

Look for Part II in the June '89 issue of 73.

Number 7 on your Feedback card

Build A Simple Az-El For Mode L

Precision antenna pointing for under $100.

by John Molnar WA3ETD

It was a week before the scheduled launch of OSCAR 13, and I had a problem. I wanted to get on Mode L on the first day, and the only antenna system available that would operate on 1269 MHz was an eight foot parabolic dish sitting in my driveway, pointed at the horizon. I needed an alternative antenna, one that would meet several important requirements unique to my QTH: It had to be pointable in both the azimuth and elevation planes (Az-El), it had to be tripod-mounted on a second story roof with limited turning radius, it had to have enough gain to be usable with a nominal amount of uplink power (about 40 Watts at the amplifier), and it had to be built with as many "available" components as possible.

What evolved is an Az-El rotor setup, tripod-mounted, controlling a pair of 24-element loop yagi antennas stacked in the "E" plane. This project was intended to be a temporary measure, one that would allow me to get on Mode L while I was working on the "final" solution. What really happened was that this easily-reproducable weekend project worked so well that it is still in place on the roof as my main Mode L array, and doubles as a weak signal contest antenna system for 1296 work. (The dish is still in the driveway, but has found use as a Mode S downlink antenna.)

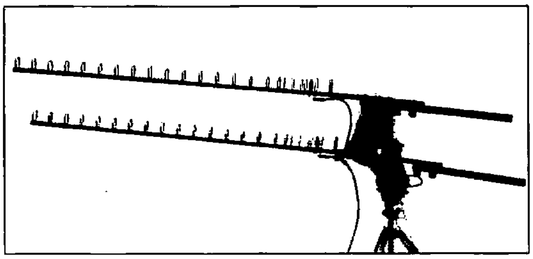


Photo A. The completed Mode L Az-El and stacked 24-element loop yagis at WA3ETD. Note "top hat" bucket that protects the elevation rotor from the elements.

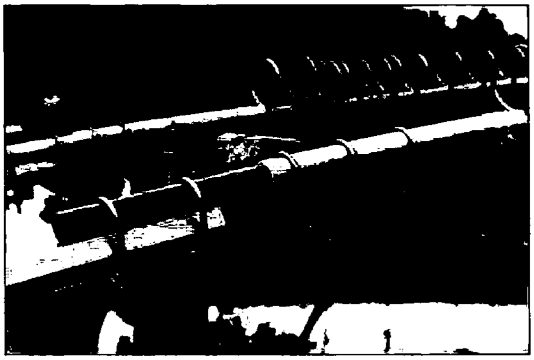


Photo B. Close-up of mounting hardware. Aluminum plate and two sets of TV U-bolts form a right angle mast-to-boom mount. The counterbalance slides on the PVC pipe, allowing adjustment for the weight of the power divider (visible below and to the right of the elevation rotor) and cable harness. A short section of steel TV mast secures the El rotor mounting plate to the Az rotor clamp. When complete, plastic end caps seal the boom, mast, and PVC tail from moisture and insects.

Az-El Rotor System

An Az-El rotor system has two functions. It must support the antenna array, and allow that array to be pointed at any point on the horizon (like your 20 meter array) as well as any point in the sky, because that is where the satellites are. I have built several Az-El systems since OSCAR 7 days, and favor a system using two separate rotors bolted together in some manner. Both rotors should be continuously adjustable and have enough resolution to point the antenna directly at the satellite in question. It is possible to use different rotors for the Az and El functions; all that is required is some means of mechanically connecting them together such that the horizontal rotor turns the vertical (elevation) rotor, which in turn supports the antenna array.

The elevation rotor typically supports the antenna array boom. The boom should be balanced to eliminate stress on the rotor, and the easiest way to balance the boom is to stack two antennas and place the rotor in the center of the boom. Thus, the boom must pass through the elevation rotor. For lightweight satellite antennas, I have found that an old favorite flea market special, the Alliance U-100, or its descendant, the U-110, work perfectly as elevation rotors, with minimal modification. These four wire control rotors and their clicker style box, designed for the home television industry, can be found in working condition at flea markets for five dollars. They work just fine on their side for elevation duty. I used a U-110 in this project. However, a U-100 modified eight years ago is still lifting antennas on my roof in the Northeast!

Most rotors will serve as the azimuth, or horizontal rotor. No modification is usually required, since the rotor is being used for turning a horizontal load. Once again, a generic hamfest CDR™-type rotor works well, especially if it has continuous control (not a "stepper"). However, a U-100 or U-110 can be used with the minor control box modification described later in this article. Kenpro (now a division of Yaesu) makes a fine azimuth rotor specifically designed for satellite service. This rotor has a flat rotating surface, tapped for bolts in four places. Almost anything can be mounted to the KR-400 rotor by using a drilled adapter plate. However, some CDR-type rotors have removable mast clamps that make them highly desirable for satellite service. Try to find one with continuous control, if possible. I was fortunate enough to have a Kenpro KR-400, obtained at a "distress sale," for my project. I used the existing mast clamp supplied with the rotor to support the elevation rotor.

So, let's get started! All you will need are two suitable rotors, some basic hardware, hand tools, and a weekend in your shop or garage.

Clamp Arrangement

Most rotors are designed to be clamped to a vertical pipe and to turn a vertical antenna mast. Some method must be devised to get the rotor to turn a horizontal mast so that the antennas can be elevated. You must make a clamp arrangement that will allow the rotor to be mounted on its side. This "90 degree clamp" can be easily created using common parts.

The idea is to mount a U-100-type elevation rotor on its side on top of a standard azimuth rotor. This can be done in two ways. If you have an azimuth rotor with a flat mounting surface, all that you will need is a six inch square adapter plate fabricated from ¼ inch aluminum plate. Or, if you use a standard mast clamp rotor, you can clamp the adapter plate to an eight inch section of standard steel TV mast (available at Radio Shack™). Then, clamp the mast section to the azimuth rotor and you will have a quick Az-El system. I used this latter approach.

Referring to Photos B and C, cut a six inch square plate of 3/16" or ¼" aluminum plate. I have successfully cut this type of plate using a saber saw with a metal cutting blade, but you could also use a hacksaw. Make sure to clamp the main piece of afuminum in a vice, and wear those safety goggles!

Most "original" U-100 rotors have four 3/16" rods threaded into the aluminum case. These served as the rotor-to-mast clamp guides, and should be removed. When looking at your U-100 or U-110, you will see an aluminum tab protruding from the rotor body, above the top set of holes originally holding the mast clamp guides. This tab is intended to prevent the rotor and antenna from sliding down the mast should the clamps become loose in TV duty. Since we intend to lay the rotor on its side on the plate, this tab must be removed. Do this by deeply scribing a line in the aluminum tab where it is cast into the rotor body. A sharp blow with a ball peen hammer at the end of the tab will usually break it off neatly at the scribe mark. I have modified several of these rotors in this manner, and once the tab took a piece of the rotor case with it, exposing the guts of the machine. No problem, a bead of RTV will seal the crack against the rain.

Now lay the rotor on its side, centered on the 6" plate. Mark and drill the plate for the four posts of the rotor. Secure the rotor and plate with 3/16" x ½" stainless hardware, and insure that it is centered on the plate.

The next step depends on your choice of azimuth rotor. If you have a flat surface on the azimuth rotor, mark and drill the plate for the hole pattern on your particular device. Then secure the plate to the rotor using several washers or small spacers between the plate and the rotor to provide clearance for the four bolt heads holding the elevation rotor. Assemble the basic Az-El by bolting both rotors to the plate.

Mounting

You are now ready to assemble a mechanically tough, compact unit. Refer to Photo B. Mount the mast clamp type azimuth rotor to the plate using a 8"–10" piece of TV mast. Drill your plate to accept two standard TV U-bolt mast clamps, and secure the plate and elevation rotor to the short mast section. Insert the other end into the azimuth rotor until it bottoms out, then measure how much mast

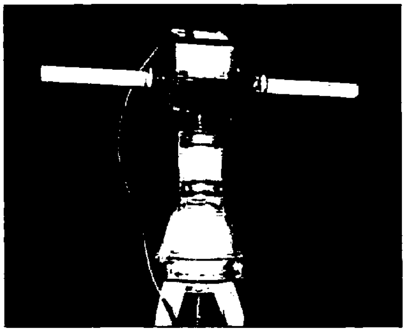


Photo D. Elements of an Az-El. In this system, the modified El rotor is united with a flea market CDR rotor with short sections of 1" od threaded water pipe components. The horizontal mast is typically about 38" long.

is between the plate and the top of the rotor. Cut that much off the mast—the goal is to rest the plate directly on top of the azimuth rotor. Secure the assembly. I have found that the slight imbalance caused by the elevation rotor being slightly "in front" of the azimuth rotor in this application causes no problems in the final assembly.

That's it! The tough part of your Mode L array is behind you. Mount the completed Az-El assembly on a piece of TV mast, and use a standard 3' TV roof mount tripod to hold it in the final position. Assuming that the tripod will be used in the final roof mount application, once again minimize the length of the TV mast—I try to rest the bottom clamp of the azimuth rotor directly on the top of the tripod.

Photo D shows another possible mounting scheme. The Az-El rotor connection is fabricated from short sections of 1" threaded iron water pipe and a "Tee" section. As you can see, many methods of coupling two rotors are possible.

Antenna System

The following minimum system results in a usable uplink: a single 45-element loop yagi (about 20 dBi gain), transmitter power output of 35–40 Watts, and no more than 3 dB of feedline/connector/SWR loss. I have worked many stations on Mode L in this class.

A pair of 45-element loop yagis results in a system about equivalent to a 4' dish antenna. I have used exactly such a dish as a reference antenna on 1269 MHz. The only problems with the 45-element looper are its physical length, about 12', and the fact that it is center mounted. Remember, the antenna is going to be pointed up, meaning the reflector end of the antenna points down, possibly into your roof or chimney, when center mounted. My solution to the size issue was to end mount two 24-element loop yagis, one on each end of a 30" boom, with the elevation rotor mounted in the center. Counterbalancing the array resulted in a nicely balanced package with the approximate gain of one big loop yagi.

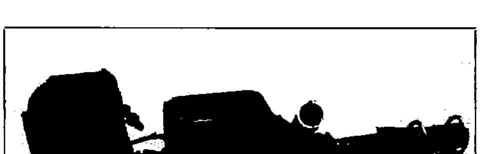


Photo C. Major Az-El components. Square ¼" aluminum plate is used to fabricate right angle mounts using standard TV U-bolts and clamps.

The loop yagis I used are sold by Down East Microwave, Box 2310, RR #1, Troy ME 04987 [(207) 948-3741]. They make antennas, power amplifiers, and components for microwave operators. If you ask for it, Bill Olson (the owner) will leave several inches of boom behind the last reflector on your 24-element looper. This makes it much easier to clamp the antenna to the "mast" running horizontally through the elevation rotor. Assuming that you choose to use the stacked 24-element loopers, make sure to request 1269 MHz driven elements as well as the mast "tail" extension when you order from Down East.

Checking Photo B, fabricate two more 6" aluminum plates. Mark and drill the plate to accept four TV U-bolt clamps, two on each side. One set clamps to the loop yagi tail, and the other to the horizontal mast, allowing the array to be elevated. This fabrication process is easy—you can bolt up the elements as you go, using a horizontal mast about 38" long. Slip the mast through the U-100, center it, and snug it down with U-bolt clamps. The goal is to position the two loopers so the antenna boom center-to-center distance is about 30", but this is not a critical dimension.

Counterbalancing

Notice how front-heavy the array seems. Although the U-100 can lift the uncounterbalanced array, all it takes is a bit of snow, ice, or wind loading to over-stress the elevation rotor. A counterbalance is a must. I fabricated a very workable counterbalance using things stacked under my work bench. There was at hand also some solid aluminum rod in the shape of an octagon about 2" in "diameter," salvaged from a local metal yard.

Secure the two yagis to the plates and horizontal mast. Free the El rotor clamps so the array swings free, touching the ground or floor in front of the tripod. Now cut two 1' long pieces of 1" i.d. Schedule 80 (thick wall) PVC water pipe, available at any hardware store. Cut a 3" slit in one end of each pipe so that it can be slipped over the tail of each yagi, and clamp the yagi to the plate by tightening the U-bolts over the PVC.

The two resulting 9" PVC tails allow the counterbalancing weights to be clamped on. In my case, the octagonal faces of the aluminum provided a ready-made surface for the U-bolt bracket. Each installation is slightly different, so judge (or use a "fruit basket scale") how much counterbalance mass is required to balance the array in the elevation rotor. Slide your aluminum bar, iron pipe, brick, or whatever forward or backward on the PVC tail until the array is balanced. Now, slide each counterbalance two inches or so forward so the array is once again nose heavy. Secure lightly. You will make the final counterbalance adjustment later, when the power divider (from Down East Microwave) and transmission line is attached to the array.

Final Assembly

That ray gun sitting in your garage is al-

most mechanically finished! Let's take a moment and consider how to feed the array from your shack. Feeding antennas at 1269 MHz is unlike your typical 20 meter, or even 2 meter, installation. Feedline selection and length are critical to the performance of your system. Connector losses really do add up, and matching everything in the system is important. If your station is in the 10-40 Watt class, strive to keep total transmission line loss below 3 dB. Needless to say, this requirement pretty well eliminates the use of RG-8 or 9913 type cables when the transmitter to antenna distance is over 35'. In my situation the transmission line is about 50', so I used an available piece of ½" Andrews foam Heliax™ from transmitter to rotor loop. A 4' piece of 9913 with type N connectors connects the transmission line to the power divider. PLEASE, do not try RG-8 coax and flea market PL-259 connectors in your installation—you are assured of being disappointed. Also bear in mind that these restrictions disappear if you have "power to burn." There are more than a few 1296 EME operators on the bird, and when you have a couple of tubes in a cavity making 300 Watts, the transmission line problems ease a bit. Once again, based on experience, the array described here can be used successfully with an ICOM 1271A 10 Watt transceiver IF line losses are kept UNDER 3 dB. Consult the Transmission Line chapter of the Handbook, or talk to a local UHF enthusiast for details. The use of Heliax transmission line is no longer considered exotic—plenty of good ½" stuff is showing up in flea markets, with connectors, having been retired from land mobile base stations.

A short piece of 9913 or 8214 line can be used to form the rotor loop. Insure that the loop is big enough to allow full 360 degree travel of the azimuth rotor. Make or buy two 16" pieces of 9913 cable with male type N connectors on each end. These MUST be exactly the same length. Connect each yagi to the power divider, either from Down East Microwave or home built (Reisert, Joe; "Power Splitters and Summers," *Ham Radio*, May 1988, pp. 80-89.). The feedline end of the power divider goes to the rotor loop. Now connect appropriate rotor control cables to each rotor, once again allowing for rotor movement. Temporarily connect control boxes and position the azimuth rotor to "South." (Use "South" for the neutral azimuth position for the loop because OSCAR 13 appears in the southeast, south, and southwest when viewed from most of the U.S.) With the clicker style elevation rotor, position it to "West," which will correspond to 0 degrees of elevation. Form rotor cable rotation loops, and tape or cable tie them to a tripod leg.

It is up to you to get this creation onto your roof or to its final resting place. Don't tell me how you did it. I used mine for a week in the back yard, on the ground, because I didn't have a helper. I did hear my own downlink signal on the "first night"—more on that later. Once you have secured the Az-El on the roof, using a tripod or chimney mount or whatever, make sure it's pointing south and at the horizon. Tighten up all the clamps—now is the time to adjust those counterbalance weights to compensate for the power divider and feed harness. Finally, heavily Krylon™ the whole thing and insert end plugs in the horizontal mast to keep the wasps out!

For the final touch, make some sort of "top hat" for the elevation rotor. I used a plastic four gallon bucket, with two cutouts for the horizontal mast. The U-100–U-110 series MUST be protected from rain. Notice how only one end has a splash ring (because the rotor was really designed for azimuth duty). Without a top hat, the rotor will be ruined in a season or so, unless it never rains. Secure the top hat with some cord, or with cable ties. Finally, ground the tripod with the aluminum ground cable available from Radio Shack. If the Mode L array is the only thing on the roof, run the 8-gauge ground wire to the appropriate ground stake or pipe. Channel the transmission line and rotor control cables to your shack, and you're ready for the final steps. Photos A and E show my completed array, using a Kenpro KR-400 as the Az rotor, and a modified Alliance U-110 as the El rotor.

Alliance U-100 Control Box Mod

You need to make one additional modification before connecting the rotors to their control boxes in your shack. The Alliance clicker style rotors allow the rotor shaft to move 10 degrees per click. You'll need much better resolution to accurately point the array in the general direction of OSCAR 13. Since the rotor motor runs continuously in between clicks, all that you need to do is find a way stop the motor in between the 10 degree clicks.

Once again, this is easily done. Power is fed to a U-110 rotor motor through terminals 1 or 2, depending upon which way the clicker was turned. You can solve the problem by installing a DPST normally-open push-button switch at the rotor control box, in series with leads 1 and 2. It works like this: Move the control knob clockwise (from "West" toward "North") to elevate the array. Remember, a setting of "West" corresponds to 0 degrees elevation, and "North" corresponds to 90 degrees, or straight up. Since the motor power leads are isolated from the rotor motor by the switch, the rotor won't move. Press the switch, hold it in, and the motor turns. After about 10 degrees of movement, the contact sender in the rotor clicks, pulsing the control knob in the switch box. However, the motor can be stopped in between clicks by releasing the switch, thereby allowing very accurate elevation settings. There is absolutely no problem in "parking" the rotor in between steps—to return to a reference setting simply hold down your push-button until the clicker reaches the indicated position and stops normally. Be careful about elevating the array past the 90 degree point. Although this is possible it is not a good idea, as the transmission line and power divider may become tangled if you elevate "over the top."

That about does it for the Az-El construction. It's time to operate!

Getting on the Air

I assume that you know how to find and track OSCAR satellites, as that discussion is beyond the scope of this article. One of the keys to successful Mode L operation is an above average 435 downlink receive station. If you can hear the Mode JL beacon clearly at around 435.651 MHz, you're in business. A mast-mounted 70 cm preamp works wonders, in case you're not already using one. Tune up to the Mode L passband center, about 435.860, as that region supports a lot of Mode L activity. As the pass proceeds, you should hear more and better quality signals as the satellite's antenna points closer to the Earth. Without fail you should hear the characteristic sound of stations trying to hear their own downlink at or very close to passband center. The corresponding uplink frequency is 1269.496 MHz. Position your new Az-El roughly on the satellite and transmit. Tune very carefully, and if all is well you will hear your downlink. Now adjust the elevation and azimuth with your push-buttons and peak up—it's not critical. I'll be looking for you—New Hampshire is semi-rare on Mode L!

Finally, be aware that, unless you are running 100 Watts or better, the early part of the Mode L window can be disappointing because the high gain satellite antenna is pointed away from Earth. I typically run about 120 Watts at the transmitter, which produces a very nice signal after line losses. However, as stated before, I heard my downlink on that first evening running 30 Watts, and the frequency correlation between up and down link had not been determined. It took about half an hour of continuous tuning to find it, but once I located it, peaking up was a simple process. I often run 50 Watts—and work more than a few stations in the 10 Watt class!

Fast, Cheap, and Easy

The project described here can definitely be completed in a weekend, for well under $100 (excluding loop yagis) if you take the effort to find and modify a couple of old rotors. The system can also be used to turn a Mode B array. However, I wanted a separate Mode L setup to minimize additional load on an already overloaded Mode B/J Az-El. Hopefully the construction tips provided will encourage you to get up on Mode L. There is a lot of bandspace up there for experimenting, and the DX gets better every day!

Finally, a caution unique to microwave operation. ANY amount of beamed energy at 1269 MHz can and will damage your vision if you allow your eyes to "get zapped." Don't wander around the front of a loop yagi array under power, and don't allow others to do it, especially when testing your array on the ground. Several weeks ago I painfully burned a finger when I foolishly moved my hand in front of a coffee can feed horn I was tuning up. The can was being driven with FIVE WATTS, a seemingly tiny amount of power by ham standards. BE CAREFUL!

See you on Mode L! 73

Home-Brew 435 MHz Crossed Yagi

Build this high-gain antenna for under $20.

by Keith A. Berglund WB5ZDP and Doug S. Howard KG5OA

So many people that I've talked to in the AMSAT booth at the various local hamfests tell me: "I'd like to get into satellites, but I can't afford the equipment!" I tell them that amateur satellite operation is like any other facet of ham radio; you can go down to your favorite radio store, "whup" out your checkbook, and buy everything you need for many kilobucks. OR, you can pick up used gear for much less than new prices, AND, where possible, save even more by home-brewing some of your equipment. One essential piece of satellite equipment that is within most peoples' ability to home-brew is the 435 MHz antenna.

Materials

My personal experience has shown that you can walk into a well-equipped hardware store and, for twenty bucks, walk out with virtually all the materials that you need for a fine 435 MHz circularly-polarized crossed yagi. Doug KG5OA and I manufactured the antenna described here using materials that are very common and easy to find.

We made the boom from a 10 foot piece of ¾ inch copper plumbing pipe, just right for a crossed yagi having 15 elements in each plane. For the elements, we used common ⅛ inch fluxless brazing rod. This material comes in three-foot-long rods and is sold by the pound at any welding supply store. We purchased three pounds worth and had some left over. We chose the copper pipe and the brass brazing rod because they are available, rigid, and can be soldered together easily. The total cost of these materials came to just under $17.00.

To complete the antenna, you will also need two N-type panel mount connectors. These N-type connectors have a good 50Ω impedance at 435 MHz. DO NOT use PL-259/SO-239 type connectors at this frequency.

The Design

A crossed yagi is nothing more than two identical perpendicular yagis sharing a common boom. Circular polarization is produced when one of the antennas is fed one quarter of a cycle (90 degrees) later than the other. You can generate this 90 degree phase shift in one of two common ways. First, if the two antennas are constructed so that all similar elements are mounted on the boom at the same location, then feed the antennas with a phasing harness having one leg a quarter of a wavelength longer than the other. This is sometimes referred to as the "time delay" method. The second method is to physically construct one yagi a quarter wavelength in space in front of the other on the boom. If you use this method, feed both antennas in phase. We selected the latter method because it can be easily constructed without sacrificing performance.

We determined the element lengths and locations by using a BASIC language computer program written by David G. Hopkins VK4ZF, based on research done by Gunter Hock DL6WU (*Ham Radio, May 1986*). I liked this program because it let me tailor the antenna dimensions based on the materials that I could easily obtain. It also gave me the option of having the elements electrically connected to or insulated from the boom (their lengths would be different). I chose the method of having the elements electrically connected because direct soldering made construction easier.

The dimensions of all of the elements, and their placement on the boom, can be found in Table 1. The two antennas are identical in every way except that one whole antenna is shifted 6-25/32 inches (17.22 cm) ahead of the other. To help in construction, I will differentiate between the two yagis by calling one the "vertical yagi" and the other the "horizontal yagi," even if it isn't quite technically correct.

Construction

The first order of business was to drill all of the necessary holes in the boom. We cleaned the copper pipe with some steel wool and then marked the locations of the "vertical" antenna elements on the boom. If I were going to make thousands of these antennas, I would have made a permanent metal jig, but, since

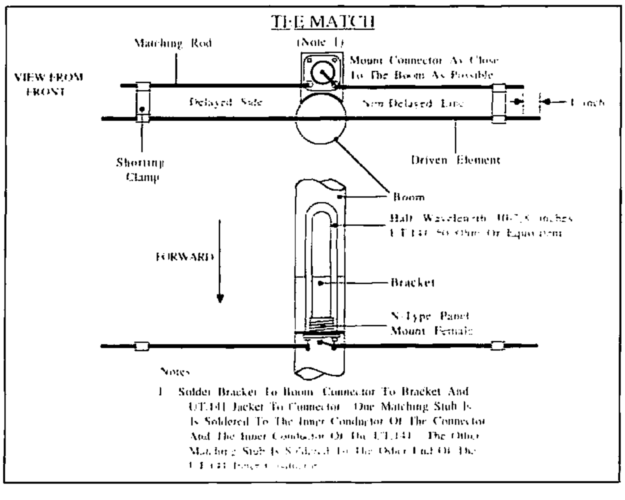


Figure 1. Construction details for the T-match.

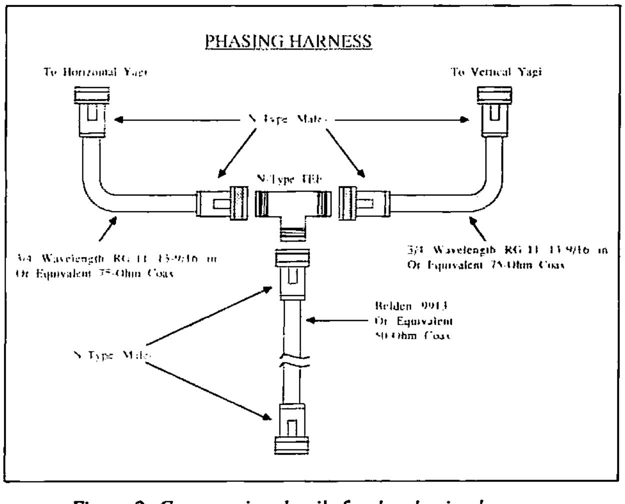


Figure 2. Construction details for the phasing harness.

we were constructing just one antenna, we made do with the materials at hand. The drilling "jig" that we used consisted of a 10 foot piece of relatively straight two-by-four. We placed the copper boom on the jig, which slid next to a guide fence clamped to the metal platform of the drill press. This fence kept the jig in the same position so that all the holes could be drilled straight through the center of the boom.

First, we drilled a ⅛ inch hole for the reflector all the way through the boom and the wood. Then, in order to hold the boom in place to drill the rest of the elements, we placed a ⅛ by 2-½ inch bolt through the wood and through the boom. When all of the vertical antenna element holes had been drilled, we removed the the bolt and rotated the boom 90 degrees. We then repeated this process for all horizontal elements.

Next, it was time to take the brass brazing rod and cut out two identical sets of 15 elements. We cut the elements with a hacksaw and then ground them to length. You should try to keep the lengths of your elements to within 1/64 inch of the given dimensions. In order to tell the difference between elements, we placed a two inch piece of masking tape on the end of each element and labeled it (D1, D2, D3, etc.).

At this point, we marked each element so that it could be accurately centered in the boom for soldering. First, we placed a pencil mark in the exact center of each element. Then, we put another mark ⅜ inch on either side of the center mark. When we placed the element through the boom, these outer marks were just visible.

We placed the boom on top of two sawhorses while we soldered the elements. We cleaned the boom with steel wool and applied flux paste around each hole and each element. Then we soldered the elements of the horizontal antenna, three at a time, using an ordinary butane torch for heat. After all of the horizontal elements were secured, we rotated the antenna 90 degrees so that the vertical elements would rest horizontally and could be attached in the same manner. While soldering, you may encounter some problems with previously soldered elements becoming soft and the element falling out. This situation can be helped by attaching a pair of vise-grips to the affected element to act as a clamp and heatsink.

The Match

After all of the elements from each antenna had been soldered in, it was time to hook up the matching system. I have found that the T-match works very well at this frequency and is easy to tune. See Figure 1 for the construction details of the T-match. We used a ½ wavelength piece of 0.141 semi-rigid 50Ω cable to construct the delay line/balun, then soldered it directly through the bottom two holes of the N-type panel mount connector. Cut the length of the cable to 10-⅞ inches, which is shorter than ½ wavelength in space, due to the velocity factor of the cable. If you can't find any 0.141 semi-rigid, you may try a piece of RG-58, although the assembly procedure may change.

We mounted the N-type connector on a 1-⅛ by 2-½ inch wide piece of copper made from a section of ⅜ inch copper refrigerator pipe. We used a hacksaw to cut a 1-⅛ inch ring of pipe, then cut the ring laterally and opened it up to form a rectangle. Next, we bent the rectangle into an "L" shaped piece and drilled it to accommodate the N-type panel mount connector. The shorting clamps were made from a ¼ inch wide piece of copper fashioned in the same manner; the matching rods were made from the same ⅛ inch brass rod as the elements.

In order to achieve right-hand circular polarization (the convention on OSCAR-10 and OSCAR-13), the T-matches must be constructed so that the non-delayed side of the vertical (forward) antenna points "up," and the non-delayed side of the horizontal (aft) antenna is clockwise from it while looking forward along the reflector end of the boom.

70 CM CROSSED-YAGI DESIGN DETAILS:			
DESIGN FREQUENCY:			435.30 MHZ
WAVELENGTH:			26-13/16 IN
NUMBER OF ELEMENTS:			15
DIAMETER OF BOOM:			3/4 IN
DIAMETER OF ELEMENTS:			1/8 IN
ELEMENTS ARE ELECTRICALLY CONNECTED TO THE BOOM!!!			
MAXIMUM PRACTICAL GAIN:			13.95 dB OVER A DIPOLE
ELEMENT LENGTHS (INCHES)			
REFLECTOR	13-19/32	DIRECTOR # 7	11-19/32
DRIVEN ELEMENT	12-29/32	DIRECTOR # 8	11-1/2
DIRECTOR # 1	12-9/32	DIRECTOR # 9	11-7/16
DIRECTOR # 2	12-5/32	DIRECTOR # 10	11-3/8
DIRECTOR # 3	12-1/32	DIRECTOR # 11	11-5/16
DIRECTOR # 4	11-29/32	DIRECTOR # 12	11-9/32
DIRECTOR # 5	11-25/32	DIRECTOR # 13	11-7/32
DIRECTOR # 6	11-11/16		

DISTANCE FROM REFLECTOR END OF BOOM (INCHES)

ELEMENT	HORIZONTAL YAGI	VERTICAL YAGI
REFLECTOR	2-1/2	9-9/32
DRIVEN ELEMENT	9	15-25/32
DIRECTOR # 1	11-23/32	18-1/2
DIRECTOR # 2	16-19/32	23-3/8
DIRECTOR # 3	22-7/16	29-7/32
DIRECTOR # 4	29-7/32	36
DIRECTOR # 5	36-25/32	43-19/32
DIRECTOR # 6	44-15/16	51-23/32
DIRECTOR # 7	53-15/32	60-1/4
DIRECTOR # 8	62-13/32	69-3/16
DIRECTOR # 9	71-25/32	78-9/16
DIRECTOR # 10	81-17/32	88-5/16
DIRECTOR # 11	91-11/16	98-15/32
DIRECTOR # 12	102-1/8	108-15/16
DIRECTOR # 13	112-23/32	119-1/2

Table 1.

Tune-Up

Tuning up this antenna is really quite simple. Insert a Bird directional wattmeter, or an SWR bridge rated for the frequency, in the line as close to the antenna as possible. Tune for the lowest reflected power by sliding the shorting bars in and out. Keep in mind that the bars should be located equidistant from the center of the boom. When you determine the correct placement of the shorting bars, solder them in place. You should easily obtain an SWR of less than 1.2:1 on each antenna.

The Phasing Harness

If you are going to feed two 50Ω antennas with one 50Ω coaxial cable, you'll need a phasing harness. This phasing harness not only splits the power between each antenna, it also matches the impedances.

The phasing harness shown in Figure 2 will feed both antennas in phase, thereby producing right-hand circular polarization. Any odd quarter wavelength of 75Ω cable will transform 50Ω up to 100Ω. Two 100Ω systems in parallel will equal 50Ω. For ease of construction, we used a ¾ wavelength piece (taking into account the velocity factor) of RG-11 cable on each side.

Connect the harness to both antennas and tape or tie-wrap it close to the boom. It would be a good idea to recheck the SWR of the system at this point. It should still be quite low.

Final Prep

We suggest two more steps before installing the antenna. First, it would be a good idea to paint the antenna. Some knowledgeable people have told us that, due to the crystalline grain structure of brass, constant exposure to the outdoor elements will make it brittle. Painting the antenna will help prevent this, and will make it look better.

Secondly, it's a good idea to somehow plug the ends of the boom. If you don't, insects such as wasps and spiders will make their homes there. We plugged the ends of our boom with a glob of silicon "pookie." This seems to have done the trick!

Results

We put the completed antenna into service at the QTH of KG5OA about six months ago. Though no official gain measurements have been made, the antenna seems to work as planned. In Mode "B", we make QSOs through OSCAR-10 and OSCAR-13 easily with 10 to 40 Watts output, depending on the satellite's attitude. In Mode "J", we've made many QSOs with the antenna mounted above the HF antenna, with 75 feet of 9913 and the preamp in the shack.

I hope that you try to home-brew at least some of your satellite station. Antennas are a good place to start. You don't have to use the exact materials or the exact methods presented here; I'm sure that other methods will work as well. Just be innovative and use the materials that are probably all around you. Good luck and see you on OSCAR-13!

AANother Turnstile Antenna

Enhanced turnstile design for hamsat operation.

by Henry Falkner ZL1AAN

Photo A. My turnstile was derived from two collinears placed back-to-back, using ¼-wave phasing sections. The antenna has survived Cyclone Bola and three weeks of unseasonal summer rain.

J-poles and Slim Jims have doughnut-shaped radiating patterns around them. Mounted vertically, they allow early signal acquisition when a satellite rises over the horizon. But on overhead passes, a couple of nulls spoil data acquisition. A Slim Jim is just an end-fed folded dipole, and therefore has no dBd gain.

It used to take me all week to get a bulletin off OSCAR 11 with a low fault rate, i.e., 500 or less misread characters for every 10K bytes of data.

Finding the Right Signal

The satellite enthusiast has to pick out one signal source in the sky, pushing out as little as 200 mW. This is like trying to find one piece of grit on a football that is covered with grit. You have to be able to recognize which piece of grit is the one you're after.

On VHF, your unwanted pieces of grit are ignition noise and strong, out-of-band utility stations, some of them mobile. They contribute to the noise on your wanted frequency because today's transceivers have untuned front ends. The first mixer has to block them as well as it possibly can.

So you write a check for the latest beam and rotator. Then you find that low-orbit satellites pass over from horizon to horizon in 10 to 20 minutes, and tracking the bird by manual control becomes hit and miss. Yes, you can use your computer to do that job for you, but you have to write out another check for the interface that talks to your rotator.

Horizontally Polarized Turnstile

There is one type of antenna that looks at the piece of sky your vertical antennas miss. This is the turnstile. It also happens that most unwanted signal sources (e.g., mobiles) radiate vertically, so their signal is vertically polarized. The turnstile looks at horizontally polarized signals. Satellites put out circularly polarized signals. It turns out that for most of a pass, a horizontally polarized antenna will give you more signal above the noise than a vertically polarized antenna.

The traditional turnstile consists of two crossed dipoles connected by ¼-wave phasing line. It needs a matching stub between antenna and feedline. The design is not considered easily matched for transmission.

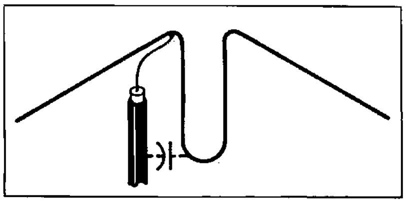


Figure 1. The basic array.

Well-Tested Design

My turnstile has four ½-wave elements at right angles. Each two are joined by a U-section ⅛-wavelength high, so you have two assemblies with a ¼-wave phasing section, as shown in Figure 1. You need two assemblies in order to avoid a sharp null. These two assemblies are joined by another U-section ¼-wavelength high. On this U-section the coax-feedline is joined, center to one leg, braid to the other. See Figure 2. For 2 meters, the feedpoint is very close to four inches below the top of the ¼-wave U-section. This feeding method acts as a balun as well as an impedance match.

I have built three prototypes, one with ⅜-inch aluminum tubing, particle board, and a PVC pipe mast section. The other two are made from ¼-inch brass tubing, which

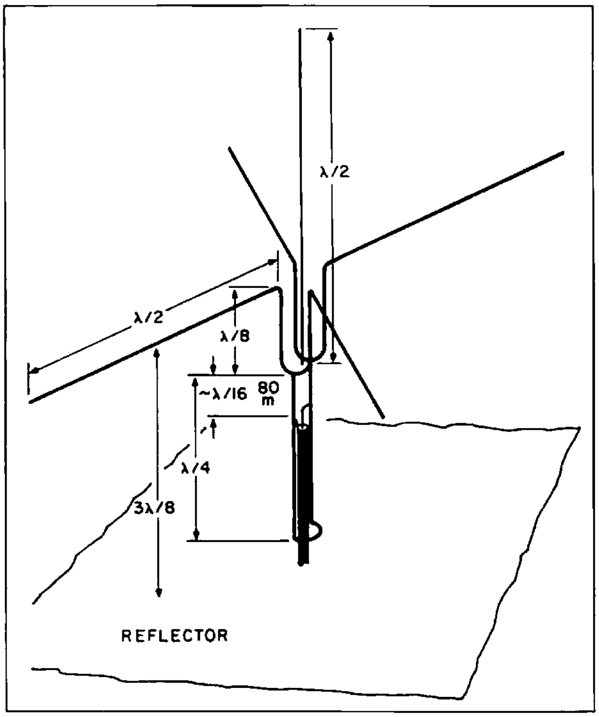


Figure 2. The turnstile has four ½-wave elements at right angles. With two assemblies, you avoid a sharp null. These two assemblies are joined by another U-section ¼-wavelength high. On this U-section the coax-feedline is joined, center to one leg, braid to the other. For 2 meters, the feedpoint is very close to four inches below the top of the ¼-wave U-section. This feeding method acts as a balun as well as an impedance match.

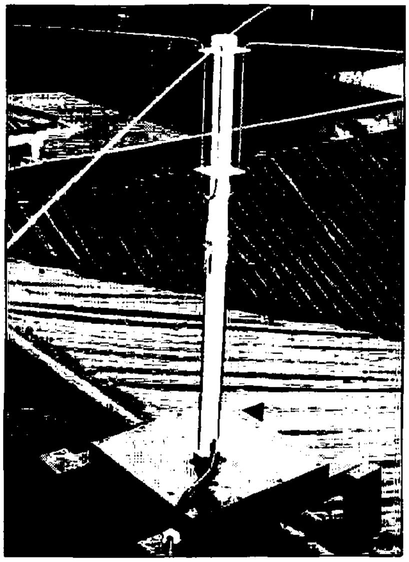


Photo B. The collinear sections are made from single lengths of ¼-inch brass tubing. The coax-feedline comes up through the PVC mast. It is matched to the turnstile by a ½-wave section joining the two collinears. The roof is the reflector.

you can bend in a vice around a piece of pipe. The photographs show the PVC supports on the ⅜-wavelength high mast section, and how the antenna is placed on the metal roof, which acts as a reflector. These three prototypes showed that the width of the U-sections is not critical. Performance is consistent among all prototypes.

"Just Take a Collinear and Bend..."

Over the last twelve months I have found that these turnstiles can receive decodable signals from less than 170 degrees longitude to more than 200 degrees longitude. Auckland in New Zealand (my QTH) is at 185 degrees longitude East. The fault rate over 10K bytes averages 100. Each week I've been able to save 5K bulletins with less than 50 errors. Frequently, the errors are as few as ten.

On overhead passes of RS-13, my downlink is as strong as a Christchurch station's using a 10-element beam. Over the whole pass, the worst reports have been 5 by 5. *Mir* was a doddle. All my six replies were acknowledged, some of them transmitted at 5 Watts instead of 30 Watts.

This design does not distinguish between right-hand and left-hand polarization. You might be able to use it as the basic element of a crossed yagi, the only drawback being the resulting dimensions at 2 meters.

Why didn't anyone think of this method before? Just take a collinear and bend the elements to 90 degrees between each other. Then replace the ½-wave phasing line with a ¼-wave phasing line, and place two of these adapted collinears back-to-back. Finally, join them with a ½-wave phasing line which matches into your coax, and you are in business.

Thanks to Irvin Spackman ZL1MO for appraisal and suggestions. ■

73 Review by Ed Clegg, W3LOY

TS-790A

Preview of Kenwood's latest OSCAR rig.

Kenwood USA Corp.,
PO Box 22745
Long Beach, CA 90801-5745
(213) 639-4200
Price Class: $2000

This entry into the goodies available to the increasing number of OSCAR 13 operators has stirred up a lot of enthusiasm and anticipation. Although I had read all of Kenwood's magazine advertisements and press releases, I had yet to see a unit, much less enjoy the opportunity to operate one from my own shack.

I am fortunate in having available an extensive complement of laboratory-grade instrumentation as a result of an earlier venture in manufacturing ham UHF and VHF equipment. Consequently, I always feel certain that the gear in my ham shack is at the peak of performance. I spend much more time tweaking and updating than I do operating. Now, I was about to have a chance to see how close a box manufactured many thousands of miles across the sea could come to approaching the performance of the satellite equipment that I treat with such tender loving care. There was no question in my mind that a single, multiband transceiver had to be inferior to the installation of receivers, converters, transverters, preamps, linear amps, power supplies, etc., that constitutes my OSCAR station.

As I unpacked the neat and compact transceiver, I became even more convinced that it would have to run a poor second in performance to my accumulation of satellite hardware. Anything that could be packed this compactly must have lots of design compromises and performance tradeoffs!

I don't think I'm unique when it comes to getting a new "toy": I want to make it play at once. I can always read the Instruction Manual later, when the band is dead. Sometimes I want to skim through the manual briefly to orient myself, but the main objective is to connect the power supply and the antenna and "make like a radio ham."

With this radio you cannot follow this routine! You'll have to STUDY the Manual to operate the features of this radio. The 790A is really three transceivers, each with three operating modes.

After several hours of reviewing the instruction manual, I later felt qualified to do more than work 146.52 simplex, but I was still hazy about using some of the more complex features.

General Operating Features

It's very difficult to describe all of the many operating features of this remarkable transceiver. Only a "hands-on" examination will let you appreciate the intricacies of the design.

First of all, the front panel's 43 switches and rotary controls are intimidating enough even before you realize that a majority of them serve different functions, depending upon the chosen position of some of the others. Unfortunately, even after intensive study of the manual, some of the interdependence of these controls is not apparent.

From the operator's viewpoint, the 790A consists of three multimode transceivers. At any given instant you can listen on two different bands with independent selection of mode, tuning, squelch threshold, volume, etc. One of these two is designated as the "MAIN" receiver, while the other serves as the "SUB" receiver. A single panel switch lets you reverse the two. The principal operating difference is that the MAIN unit also functions as the transmitter. The SUB Receiver will continue to serve its selected functions regardless of the current mode of the MAIN unit. The frequency of either unit can be tuned without affecting the other. The only limitation is that the MAIN and the SUB may not be on the same band.

The selected status of the MAIN and the SUB sections can be exchanged at any instant by means of the MAIN/SUB function key. Each section has an A and B VFO, selectable at will. Either active section can be switched to operate from any one of 59 programmed memory frequencies; all attributes of mode, offset, CTCSS, etc., are retained in memory. Flexibility of frequency, mode, offset, tone, squelch, audio volume, etc., is virtually unlimited. I don't have the time or the space here to include ail of the many more things that you can do with this unitl

Satellite Operation

Although the TS-790A can fully service the operating needs of any VHF/UHF/microwave enthusiast, it will probably appeal principally to the ham who operates (or plans to operate) using the OSCAR, UoSAT, JAMSAT and RS Satellites.

Unfortunately, the unit I received to review did not have the optional 1200 MHz module, UT-10. So, I was unable to put it through its paces on OSCAR 13, Mode L. I was, however, able to do all of the other exciting things provided by both OSCAR 10 and OSCAR 13 on Modes B and JL. In addition, I had two QSOs with Alexander U4MIR, on the Russian MIR space platform. All this in just a few days!

Automatic Down Link Frequency Finder

One of the problems that I have had with my present equipment has been the need to set my separate receiver and transmitter to the appropriate uplink and downlink frequencies, corrected for Doppler and the round trip time delay. The TS-790A neatly solves this by allowing you to program into memory the appropriate numerical value representing the sum of the uplink and downlink frequencies, a constant for each of the satellites. You can store and retrieve this number for as many as ten different transponders, then just tune the SUB receiver to the desired frequency and push the SAT key. This will automatically move the MAIN unit to the appropriate transmit frequency. Alternatively, you can set the MAIN section to the desired transmit frequency first, and then push the SAT key. The SUB receiver will automatically move to the appropriate down link frequency. I am certainly going to miss this capability when I have to relinquish the 790A and am forced to do it the hard way again.

I found only one area where the transceiver needed help. On both 2 meter and 70 centimeter operation, the input signal required to activate the S Meter was far in excess of the level of signals received from existing Phase III satellites. This is not necessarily a bad thing because, except for installations with very short feedlines to the antenna system, you'll want to install a preamp at or near the antenna.

In my specific installation, the GaAsFET preamplifiers determine the system noise floor. With these in line, the TS-790A S Meter is indeed quite comfortably scaled. incidentally, the MAIN section has a conventional analog meter for signal strength display, while the SUB section boasts a very fine resolution LCD display for signal strength. I was pleasantly surprised to measure the actual noise-floor of the receiver on both 2 meters and 70 cm at about 0.019 fV (for 3 dB S+N/N). Adding my GaAsFET preamp improved this by about 2 dB to 0.015 fV.

MANUFACTURER'S SPECS

General

Frequency Ranges:	144 to 148 MHz 430 to 450 MHz 1240 to 1300 MHz
Power Requirement:	13.8 VDC 2.5 A Receive (no signal) 8 to 12 Amps on Transmit depending on frequency and mode.
Dimensions (WxHxD):	13-15/32" x 5-9/32" x 14-17/32" (342 x 134 x 369 mm)
Weight:	20.2 pounds (9.2 kg)
Freq. Stability:	Less than 3 PPM (except on FM)
Operating Temp:	−10 to +50 degrees C. +14 to +122 degrees F.

Transmitter

Output Power:	2 Meter Band	35 Watts LSB/USB 45 Watts CW/FM
	70 cm Band	30 Watts LSB/USB 40 Watts CW/FM
	23 cm Band	10 Watts all modes
Spurious Radiation:	2 Meters/70 cm	Less than −60 dB
	23 cm	Less than −50 dB
Carrier Suppression:		More than 40 dB (1500 Hz reference)
Unwanted Sideband:		Down more than 40 dB
Maximum FM deviation:		+/−5 kHz
SSB Freq. Response:		400 to 2600 Hz at −6 dB
Microphone Impedance:		600Ω

Receiver

NOTE: The TS-790A actually has two receivers for each of the three bands; a "MAIN" and a "SUB" receiver. At any given time it is possible to operate the unit with two independently controlled receiving systems active. The only restriction is that the two receivers must be on separate bands.

Circuitry:	2m Band	SSB/CW—Single Conversion FM—Double Conversion
	70 cm Band	SSB/CW—Double Conversion FM—Triple Conversion
	23 cm Band	SSB/CW—Triple Conversion FM—Quadruple Conversion
Sensitivity:	SSB/CW	Less than .16 fV @ 10 dB S+N to N all bands.
	FM	Less than 0.22 fV at 12 dB SINAD on all bands.
Selectivity:	SSB	2.1 kHz at −6 dB 4.8 kHz at −60 dB
	CW	500 Hz at −6 dB 2 kHz at −50 dB
	FM	12 kHz at −6 dB 24 kHz at −60 dB
Audio Output:		1.5 Watts across 8Ω load at 10% THD

(There is also a TS-790E model with somewhat different specifications, principally more restricted frequency coverage.)

Power output on both bands was in excess of that specified by Kenwood. I was initially surprised at the specified higher output ratings for the FM modes vs. the SSB modes. Presumably this is a function of linear range vs. saturation operation for FM. The unit employs multi-stage "bricks" for all the RF Power stages on both 70 cm and 2 meters, and as the driver stage on 1200 MHz. A discrete bipolar transistor serves as the 1200 MHz PA.

Summary

Early in this article I expressed my doubts regarding the ability of a package as compact and attractive as the TS-790A to have the capability to compare favorably with a multi-component dedicated satellite assembly of equipment. I can now say that my doubts were unfounded. Other than the definite desirability to add external low noise preamps, this unit matches my equipment across the board. And the XYL might let me bring a package this attractive up from the basement "studio"!

I have only one major concern about operation with transceiver-type multiband equipment. You must be very, very careful to never activate the transmit function on the band where you have your receiving preamplifier, or goodbye, GaAsFET. Once you're comfortably familiar with the MAIN and SUB sections of this unit, this situation shouldn't be too high a probability. But, I nearly did it twice. Fortunately the MAIN was in the SSB mode with the microphone gain all the way down. Whew!

I have neglected to say as much about the FM operation and the many scanning features as the radio deserves. Look for a full report on this unit in a future issue of *73*. 73

Mode S Receive Techniques

Here's how to get on hamsat's newest active mode.

by John W. Molnar WA3ETD

Most satellite operators are familiar with the systems required to access OSCAR-13's Mode B and Mode L. However, OSCAR-13 offers yet another challenge—Mode S—which requires the user to receive an S-band microwave downlink signal at 2400.325 MHz.

The Experimenter's Mode

For now, the only Mode S transponder can support a couple of simultaneous QSOs. Right now, simultaneous QSOs are infrequent, but the trend in amateur satellites is toward our higher microwave frequencies that can support high speed digital communications as well as all the conventional modes.

This article describes several receive-only systems that will allow the experimenter to copy the Mode S downlink and beacon. (The Mode S uplink is in the 70 cm band.) If you already own a 2304 MHz transverter, you are well on your way to receiving the Mode S beacon. I will describe the minor modifications which allow the LMW 2304 and SSB Systems transverters to receive on 2400 MHz. I will also discuss the required low noise preamplifier, and the antenna systems.

LMW Transverter Mod

In my initial attempt to copy the Mode S beacon, I used an LMW 2304 transverter with IF output at 144 MHz. This medium-priced transverter is marketed by *Down East Microwave, Box 2310, RR 1, Troy ME 04987, (207) 948-3741.* The local oscillator uses a 93–95 MHz overtone crystal, multiplied twelve times. The resulting signal is directly used in the LMW 1296 transverter, and is doubled to the 2160 MHz range in the 2304 MHz unit.

You can convert the LMW to 2400 MHz for Mode S by replacing the Local Oscillator (LO) crystal, retuning the LO, then retuning the receive mixer. The only difficult part of the conversion is retuning the filters on the LMW Universal LO board. They are very sharp. Some method of determining RF output at 1128 MHz is necessary, such as a diode RF probe and sensitive voltmeter.

Obtain a 94.00 MHz fifth overtone series crystal from your favorite quartz outlet. Replace the existing crystal with the new one on the UVLO board. Disconnect both LO output cables from the points marked "X" and "Y" on the board. The LO should tune up with no problems at 94.00 MHz.

I found that the fastest way to accomplish the tune-up was to listen for the progressively higher harmonics on a VHF receiver (or scanner). Observe the output at point "Y" on the board, and peak it with VC9. Although output point "Y" originally provided LO for the transmit mixer, I used it to drive the receive mixer, as the additional output allows some margin for error when peaking the filters, VC5–VC7. Note that the tune-up procedure offered in the LMW manual will also work, since the new crystal is within the operational range of the UVLO board.

Once the LO is tuned up, it is a simple matter to peak up the receive mixer. The only critical adjustment is VC5 on the mixer board. A signal source is required to peak up the mixer. Most signal generators provide output at 150 MHz, and the 16th harmonic of 150 MHz is 2400 MHz. Again, I found that the only adjustment required on the mixer is VC5. Adjusting the preceding amplifier sections had no real effect because the stages are very broad. Once the following step has been completed the LMW transverter is ready for Mode S.

SSB Transverter Mod

Another transverter suitable for 2400 MHz work is the SSB Electronics unit available from *Transverters Unlimited, Box 178, New Boston NH 03070.* The required components are the SLO-13, the local oscillator, and the SRM-13 receive mixer. These modules are provided with BNC connectors for system interconnections.

The SSB components are a snap to convert. You only need to swap crystals! Replace the existing rock with the 94.00 MHz crystal specified for the LMW unit. The SSB LO uses the same multiplication scheme: crystal frequency x 24 plus 144 MHz IF = receive frequency. The filters in the SSB unit are obviously not as sharp as those in the LMW, as no adjustments were required to copy the 2400 MHz test signal.

Low Noise Preamplifier

Both receive mixers described above have internal low noise preamplifiers with noise figures in the 1.5–2.0 dB range. Considering the received signal levels and feedline losses at 2400 MHz, you need a high quality external preamp for this application.

Last fall, Al Ward WB5LUA presented a paper on state-of-the-art low noise preamplifiers at the Microwave Update 1988 convention. I acquired one of his S-band preamp kits, which uses an ATF10135 device, and has a noise figure of around 0.6 dB. Al offers his PC board and device through the mail, and it is a natural for Mode S (or 2304 weak signal work) downlink. In fact, it's necessary. Write him at *AL Ward WB5LUA, Rt. 9 Box 132, McKinney, TX 75069.* You can build the preamp in an hour. It doesn't need a tune-up.

Antenna System

You need an antenna system with gain of 25 dBi or better to copy Mode S. I used a four-foot parabolic dish originally used by Public Service for point-to-point communications. This dish has a focal length-to-diameter ratio (f/D) of 0.375, which puts it at the outer limit of being easy to feed with circular feedhorn. I constructed a custom coffee-can feed using copper roof flashing, although I believe an actual one-pound coffee can would work at 2400 MHz.

About the circular waveguide feedhorn for 2400 MHz: The horn is 5.125" long and 3.25" in diameter. There is a 1" probe made of #12 bare copper wire soldered at the center conductor of a Type "N" panel connector. The connector is then soldered to the feedhorn. The center conductor and probe are exactly 2.9" above the closed end of the feed.

For specific details on microwave feedhorns, refer to the *ARRL Handbook* and the RSGB *VHF/UHF Manual.* Any dish four feet or more in diameter should work as long as you are able to point it at the satellite at apogee. You could also use yagi antennas, but you would have to stack several of them to obtain the necessary gain. Four Down East Microwave 45-element loop yagis, stacked, would possibly work, and have much less wind loading than a dish. As far as the numbers go, the four-foot dish at 2400 MHz has 26 dBi of gain, assuming 50% feed efficiency. Four 45-element loop yagis exhibit about 25 dBi when stacked.

Putting It all Together

The preamplifier should be connected as close to the feedhorn as possible. I connected the WB5LUA preamp to my horn with 6" of 0.141" semi-rigid hardline, and used a 24" piece of 9913 to connect the preamp to the LMW transverter sitting below the dish. The LMW has enough gain at 144 MHz to drive a 10-foot piece of 9913 running into my basement shack. A motorcycle battery provided power to the LMW. I was able to copy the Mode S beacon during initial tests with this system. Signals were 4 to 6 dB above the noise.

Hopefully, this information will tempt you to try Mode S. If you are already on 2304 MHz, you could have a usable station for the cost of a crystal and a preamp which will serve you well during the next UHF contest. Consult the normal AMSAT information outlets for Mode S scheduling, as the transponder is not activated on a regular schedule. For more information on Mode S, you can also contact *Bill McCaa KØRZ, Box 3214, Boulder CO.*

Number 31 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free on a space available basis. To make our job easier, and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8½" x 11") sheet of paper. Use upper- and lowercase letters, and print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Thank you for your cooperation.

Wanted: Used shortwave receivers—Japan Radio NRD-515, ICOM R-71A, Kenwood R-5000 or Yaesu FRG-8800, etc. Please send information on price and condition. Thank you.

Steve Hayes
5900 218th Ave. E.
Booney Lake WA 98390

Needed: A schematic and/or manual for the SWAN 350B. I will gladly pay all costs in reproducing/mailing. Thanks.

Gene A. Hill/ZS6ATG
(N5JRC)
Pretoria/Dept. of State
Washington DC 20520-9300

Wanted: Source for new or used Touchtone™ pad and front panel for Heath VF-2031 Handi-Talkie. Heath has discontinued. Thanks very much.

Bob Workman WA4ZZN
PO Box 942
Atlantic Beach NC 28512

Desperately seeking reasonably priced schematic for grid dip in pints or quartz. Any info appreciated. Tnx.

Mac PH0NEY
Yellow Brick Rd. W.
SE Central Vassalboro NH

I need a manual/schematic for a Yaesu FTdx 560 transceiver. Will pay for any costs.

Martin Roe WB0JNV
4903 Riverside Trail
Berrien Springs MI 49103

I need a RTTY program for the Commodore 64 to use with my home-built RTTY demodulator. I need a program I can type in.

Randall Reese
45 House, Apt. 504
8/1 Sukhumvit 45
Prakanong
Bangkok Thailand

Wanted: Instruction manual (tube element settings) for Lafayette Tube Tester Model TE-55. Will pay photocopy and postage. Please help!

Jock Fisher VK1LF
PO Box 94
Lyons, Canberra
A.C.T. 2606 AUSTRALIA

Please help, need diagram or book and DB Meter for N T 46154B (RBA-7), Serial no. 1820.

E.J. Ainsworth K5OPO
Star Route Box 120
Braxton MS 39044

Need for Hallicrafters HT-37 transmitter: control-socket plug 86-PM11 Amphenol (has 11 pins), and microphone plug 75-MC1F Amphenol (has one center contact and screws on). I would appreciate any help. Please write with price.

Rick Bledsoe
HCR 1 Box 4004
Shell Knob MO 65747

Old manual needed! I just picked up a Hallicrafters SR-150 rig, and need to get a copy of the operator's manual and schematics. I will gladly pay any reasonable costs incurred. Thanks very much!

Jim Bail KA1TGA
19 Granite Street #6
Peterborough NH 03458

I am looking to complete a collection of U.S. and Canadian ham-call license plates to go on display. I will pay any reasonable mailing costs incurred. Thanks!

Bryan Hastings NS1B
64 Concord Street
Peterborough NH 03458

AMSAT Satellite Tracking Software

Pick from a passel of great tracking programs.

by Keith Pugh W5IU

Predicting when to listen for a satellite and where to point the antennas are basic requirements for successful amateur satellite communications. Before home computers, Equator crossing information was published and used with graphic devices, such as the OSCAR LOCATOR, to keep up with the low-altitude satellites with circular orbits. These methods are satisfactory, inexpensive, and still used today. However, graphic tracking methods for the Phase III, high-altitude satellites with the more complex elliptical orbits are much less satisfactory. Satellite tracking by home computer has become very popular.

Good Idea at the Right Time

AMSAT Satellite Tracking Software began with an article titled "BASIC Orbits," by Dr. Tom Clark W3IWI, in the March/April 1981 issue of *Orbit* magazine. He described his program, written in North-Star Basic, in detail, and provided the program listing.

President of AMSAT at the time, Dr. Clark donated the rights to the program to AMSAT and thought of starting the AMSAT Software Exchange as a medium for distributing the program and collecting donations for AMSAT from users. Having just suffered the loss of the Phase IIIA satellite, AMSAT badly needed funds to begin the Phase IIIB project.

Not everyone had a North-Star computer, so many hams converted the program. As versions tailored to other computers appeared, the authors donated the rights to AMSAT, and the programs were added to the AMSAT Software Exchange. Programs became available for virtually all of the popular home computers.

Hams, being hams, were not content to simply translate this program to other computers. Many hams enhanced the program so that it would permit real-time operation, do graphics, and be friendlier. Dr. Bob McGwier N4HY stands out for contributing a "fast search algorithm." This key modification led to the QUIKTRAK series of programs.

What started as one program and an idea for the AMSAT Software Exchange has blossomed into the premier fund-raising program for AMSAT and a body of sophisticated satellite prediction/tracking software for virtually all home computers.

Show and Tell

Hams created further capabilities, such as computer control of antenna pointing and automatic receiver/transmitter control for Doppler correction. I call these features "Show and Tell." Graphics, automatic antenna and station control, for example, are the "Show" and the basic tabular data output is the "Tell."

These programs give predictions for any satellite with Keplerian data, including weather satellites, the US space shuttle, and the Soviet space station *Mir*. You can use the information for visual observation as well as for antenna pointing. The new QUIKTRAK Version 4.0 will also provide predictive capability for the position of other celestial bodies.

BASIC Orbits and QUICKTRAK

Before launching into detailed descriptions of the programs, I give generic descriptions of the BASIC Orbits (W3IWI) and QUIKTRAK programs for reference.

BASIC Orbits (W3IWI): Prediction is based on Kepler's equations for any elliptical satellite orbit, including the circular orbit, since no orbit is perfectly circular. In addition to the classical Keplerian element set of six numbers, a seventh derived element, Mean Motion Rate (also decay rate or drag factor in orbits per day), has been added improve accuracy principally on low-altitude "birds."

The six primary elements are: (1) Inclination (degrees), (2) Eccentricity (dimensionless), (3) Argument of Perigee (degrees), (4) Right Ascension of Ascending Node (degrees), (5)Mean anomaly (or orbit "phase") at reference epoch (degrees), and either (6) Semi-major axis of ellipse (kilometers) or (6) Mean motion (orbits per day). A definition of each of these elements is available in *The Satellite Experimenter's Handbook* and in the original *Orbit* article. In the US, NASA/NORAD generate these Keplerian element sets, and NASA distributes them by subscription. AMSAT distributes them through its nets, publications, and computer BBS.

You must enter the Reference Epoch (valid time for the element set), with the element set as a starting point for extrapolation to the predicted time. You can also enter a default satellite beacon frequency (or net passband frequency) for computation of Doppler correction along with the Keplerian data.

Keplerian elements and your QTH data are stored within the program as DATA statements, making the updating of the program rather tedious. You can store multiple sets of Keplerian elements (usually 20). Fortunately, you won't need to update very often, except the data for very low-altitude birds, such as UoSAT OSCAR 9, the US space shuttle, and the Soviet space station *Mir*. Your QTH data consists of: (1) your call, (2) station latitude (degrees), (3) station longitude (degrees), and (4) station altitude (meters). This program also includes a table of Greenwich Sidereal Times on January 0.0 in days for various years. You must update this sidereal table periodically, by editing the DATA program statements, to keep it current. The original table covered 1979 through 1985.

When running the program, you will be prompted for entry of: (1)Start time, (2)Duration of the prediction period, (3) Time step between predictions, (4)Satellite of interest, (5)Frequency for Doppler correction (default or new entry), and output device (screen or printer). In most cases, you can select to output data at all times or just when the bird is in view. After you enter this information, the program will step through the predictions methodically.

Output from the program consists of: (1) Date, (2) Time in UTC, (3) Azimuth in degrees relative to North (0=North, 90=East, 180=South, and 270=West), (4)Elevation

in degrees relative to the local horizon (0=on the horizon, 90=straight up), (5) Sub-satellite point (latitude and longitude of the point on the Earth's surface directly below the satellite), (6) Range from your station to the satellite, (7) Height of the satellite above the Earth, (8) Orbital phase (0-256), and (9) Doppler correction in Hertz.

Only Date, Time, Azimuth, and Elevation are necessary for most operations. This program is perfectly adequate for all satellite tracking. It is the basis for all other AMSAT programs with the exception of the new QUIKTRAK Version 4.0. Dr. Tom Clark W3IWI deserves a round of applause for this excellent work.

QUIKTRAK

From its roots in the W3IWI program and the AMSAT AMS-81 project for the Timex/Sinclair ZX-81 computer, QUIKTRAK, by Dr. Bob McGwier N4HY has evolved into one of the most useful satellite prediction programs ever written. He borrowed the prediction algorithm from W3IWI and evolved the menu structure from the AMS-81 program. AMS-2064, one of the original programs for the Commodore Vic 20 and C-64, also shares this menu structure. To this solid beginning, Dr. McGwier added his own Newtonian fast search algorithm. This algorithm bypasses the long, step-by-step search for the Acquisition of Signal (AOS) and Loss of Signal (LOS) times. N4HY's algorithm has added practicality to the SCHEDULE mode in the AMS-81 and AMS-2064 programs.

N4HY originally wrote two versions of QUIKTRAK for a Commodore C-64 and the IBM-PC in BASIC. The user interfaces are almost identical. I will discuss these programs in two sections: common features for both programs and features unique to the IBM-PC. Compiled versions of both programs are supplied for increased speed. There are two versions of this program for the IBM-PC; one that uses the standard processor only, and another that takes advantage of the additional calculation speed the math co-processor offers.

Common Features: Both programs have: (1) SCHEDULE Mode, (2) TRACK Mode, (3) QTH DATA file handler, and KEPLERIAN DATA file handler.

For each orbit of the selected satellite above the horizon at the QTH, SCHEDULE mode provides a listing of (1) Date and time of Acquisition of Signal (AOS), (2) Date and time of Loss of Signal (LOS), (3) Peak elevation angle for circular orbit satellites or maximum distance between two observers for elliptical orbit satellites, (4) Time for peak elevation or maximum DX, (5) Azimuth for peak elevation or maximum DX, and (6) Orbit number. You can display or print out a satellite's schedule for an entire month and scan it for the best passes.

The TRACKING Mode provides the detailed display/printout of data for each pass. The same data is available in this mode as the W3IWI program output. Of course, you can enter this mode without running the SCHEDULE mode first.

Using the QTH DATA file handler, enter your station data, such as call, latitude, longitude, altitude, year, angular update interval (most versions), printer parameters, and colors, in the case of the Commodore program. Data is automatically saved on exiting.

Use the KEPLERIAN DATA file handler to enter Keplerian data for up to fourteen satellites. Change data by overwriting old data. Saving data is as above.

These four features provide a complete, user-friendly program for all of your satellite prediction needs. Data maintenance, advance planning, and increased speed are real advantages over the original W3IWI program.

IBM-PC Features: WINDOW TRACK, and its companion WINDOW TRACK DATA or CITIES file handler, compute the mutual visibility between your station and your friend's station in Tasmania through OSCAR 13. You can display computations for your QTH and up to fourteen other user-specified locations throughout the world for any satellite. Enter the geographical name, latitude, longitude, and altitude for each location in the same manner as Keplerian or QTH data using the WINDOW TRACK DATA or CITIES file handler.

Elliptical orbit satellites, such as OSCARs 10 and 13 are "spin stabilized;" their antennas point toward the center of the Earth from apogee under ideal conditions. When illumination of the solar panels is not ideal, the attitude of the satellite is "squinted" or "off-pointed," and communications capability is compromised. At other times, the satellite points away from the Earth to varying degrees due to the changing angles between your QTH, the satellite, and the attitude of the satellite's spin axis.

Using Bahn Latitude and Bahn Longitude as measures of the satellite attitude relative to the orbital plane, QUIKTRAK computes the off-pointing angle (PA) for each step of the prediction. A PA of zero degrees means that the satellite antennas are pointed directly at your QTH at that time. A PA of 90 degrees means that the satellite antennas are perpendicular to the line of sight between your QTH and the satellite position.

From this information, and with knowledge of the satellite antenna beamwidths, you can understand the variation in signal quality. Satellite control stations use this information in planning the mode schedule. For example, Mode L is scheduled for orbital phases when PA is at a minimum, since its antennas have narrower beamwidths than Mode B. Mode S is even more critical than Mode L. Understanding this, you won't waste time operating when signals are weak and spin modulation heavy due to off-pointing.

You can enter the satellite mode of operation vs. its orbital phase along with the Keplerian data in order to display the correct operating mode with each line of data. In the nongraphics versions of QUIKTRAK, you can only specify this schedule by orbital phase. In the graphics versions, you can also specify mode by the day of the week for satellites that don't schedule mode by orbital phase.

On most of the nongraphics versions, you can change from the total angle-change increment method of TRACK mode output, to W3IWI's time-increment method by following the starting time entry with the letter "t." You will then be prompted for the time increment period.

QUIKTRAK in this form still does not have the fancy graphics of the "Show" programs, but it certainly has the "Tell." The IBM-PC version is the root program for the APPLE, TRS-80 Model 4, and CP/M versions.

IBM-PC/XT/AT and Clones: N4HY QUIKTRAK 4.0

This is AMSAT'S premier program. It is a many-featured satellite prediction, tracking,

AMSAT Satellite Tracking Programs

Computer	Program Name	Generic Type	Memory	Dist. Media
IBM-PC	QUIKTRAK 4.O	QUIKTRAK	640K	5¼ & 3½ disk
IBM-PC	ORBITS 2	W3IWI	256K	5¼ disk
IBM-PC	ORBITS 3	W3IWI	>256K	5¼ disk
IBM-PC	QUIKTRAK 2.1	QUIKTRAK	64K	5¼ disk
C-64	SUPERTRACK	QUIKTRAK	64K	5¼ disk
C-128	ORBIT	W3IWI	—	5¼ disk
APPLE	APPLE QUIKTRAK	QUIKTRAK	64K	5¼ disk
APPLE	APPLE W3IWI	W3IWI	<48K	5¼ disk
APPLE	KØRZ AUTO-TRACK	W3IWI + CIRC.	<48K	5¼ disk
TRS-80 MODEL 4	N4HY QUIKTRAK	QUIKTRAK	64K	5¼ disk
TRS-80 MODEL 1	W3IWI	W3IWI	32K	cassette
TRS-80 MODEL 3	W3IWI	W3IWI	32K	5¼ disk
TRS-80 COLOR	W3IWI	W3IWI	32K	cassette
TRS-80 MODEL 100	AUTO-TRACK	W3IWI	<32K	cassette
ATARI	W3IWI	W3IWI	—	5¼ disk
TI99/4A	W3IWI	W3IWI	32K	cassette
HP-41	ORBIT I	W3IWI	—	mag cards
HP-41	ORBIT II	W3IWI	—	mag cards
CP/M	N4HY QUIKTRAK	QUIKTRAK	64K	various disks

and planning package, based upon new algorithms developed by Dr. Bob McGwier. Written in "C" and compiled for speed, it supports all features of IBM-PC QUIKTRAK along with the following features:

(1) User-selectable EGA-VGA or CGA graphics. Satellites are displayed in real-time on a map of the world. For the single satellite tracking mode, two scale factors are supplied: (a) the whole world and (b) one level of magnification around the satellite's position. A second graphics mode displays multiple satellites on a world map. In the single satellite graphics mode, you can also display the satellite footprint, the Sun line, the satellite groundtrack, and all pertinent numeric data. For educational and planning purposes, you can speed up the action and obtain a vivid demonstration of orbital dynamics. A new and highly detailed map, containing geographical boundaries, comes with the EGA-VGA graphics.

(2) Real-time tabular data screen for multiple satellite visibility from your QTH. This includes AOS and LOS status for each satellite. Data lines are color-coded for easy recognition of out-of-view, in-view, or transitioning conditions.

(3) Real-time tabular data screen for one satellite to your QTH and multiple other locations selected from the CITIES file. Data lines are as above. Pointing-angle information is displayed for all locations.

(4) Displays Equator crossing data or apogee times and location.

(5) In all prediction modes, you can send data to the screen, the printer, or a disk file.

(6) ANSI.SYS is not used in any form (as it was in Version 3.2). Screen manipulations are done by optimized routines and write directly to the screen for maximum speed (not great for DoubleDos or DesqView, but speed is essential in manipulating EGA-VGA graphics files, since they are over 112,000 bytes for each screen when fully expanded).

(7) All internal timekeeping is done in true Julian days from January 1, 1954, the year of the first satellite launch. There will be no more leap year anomalies from trying short cuts.

(8) Visible satellite (*Mir*, the space shuttle, etc.) Search and Track features for those who are interested in visual observation. This routine checks to see if (a) the satellite is above the horizon, (b) the Sun is more than ten degrees below the horizon (it is dark), and (c) whether or not the satellite is in the sunlight (not in eclipse). No moonlight phenomena are accounted for. Of course, it does not predict cloud cover.

(9) A new Window Search feature allows you to choose two of 101 cities (included in your data files, and which you may modify), to find windows of mutual visibility.

(10) The Auto Tracking function (antenna rotor and radio control) is enhanced to include multi-satellite functions, both tabular and graphic. You choose the order in which the satellites are tracked internally with the data editor. This establishes tracking priority. There is a great deal of flexibility in setting up frequency data, since frequency changes with satellite mode, etc. The interface support is identical to the one supplied with with the Kansas City Tracker and Tuner. You will need your own TSR (terminate and stay resident) driver to run any other interface.

(11) You can now choose between Mean Anomaly (measured in degrees) and Orbital Phase for display in the real-time tracking functions.

(12) In the real-time, single satellite, tabular mode, you can display all of the data you could possibly want regarding the satellite's orbital mechanics.

(13) One hundred satellites are in each satellite data file. One hundred cities, in addition to your own QTH, are stored in each city data file. You can keep as many of these files as the hard disk drive will hold.

(14) All data entry is in full-screen editors. Automatic data reading and loading functions read the NASA/NORAD two-line format or the AMSAT format.

(15) All function selection is menu-driven.

(16) There is also an optional program for tracking the sun, moon, and planets. You can listen to Jupiter and sun noise. These routines are more accurate than other widely used programs. Routines which have corrections for parallax, mutation, etc., are included.

". . . (A-O-10, A-O-13) antennas point toward the center of the Earth from apogee under ideal conditions."

ORBITS 2

Written by Roy Welch WØSL, this program provides moderate graphics and tabular data capabilities more than adequate for all amateur radio satellite operator needs. Based on the original W3IWI program, its ancestry is obvious in the batch output functions for a single satellite. But the similarity ends there. To use the graphics functions, you need the equivalent of an IBM Color Graphics Adapter and a color display. Its major features are:

(1) Real-time satellite tracking in tabular or graphics mode. You can track up to eight satellites in this mode at a time. In graphics mode, the map is in a single color of the user's choice on a black background. You can select a single, high priority satellite and footprint. All eight satellites will continue to move on-screen in real-time.

(2) Automatic control and tracking of the high priority satellite. You can control antenna azimuth and elevation rotors with the Kansas City Tracker interface.

(3) A batch output mode is provided for one satellite at a time, similar to the W3IWI prediction program. Select screen or printer.

(4) You can enter Keplerian elements into three different files which contain up to eight satellites each, with menu-driven switching. This permits the tracking and prediction routines to use any of the three files. You can display all eight satellites in a given data file with the display routines.

(5) Enter ground station geographical data under program control. Besides the color, you can also decide how you want the map presented on the screen (centered at 0, 90, 180, or 270 degrees longitude).

(6) Compiled for speed. There is also a version that works with a math co-processor as well as the standard processor version.

(7) Extensive prompting throughout, including error routines to protect against improper or invalid input to prompts. You can also print out the documentation file which contains the operating instructions.

While not as feature-loaded as QUIKTRAK 4.0, this program provides all the necessary data along with good real-time capability, graphics, and auto tracking.

ORBITS 3

Functionally, this program is equivalent to ORBITS 2, but it is also designed to take advantage of the IBM Enhanced Graphics Adapter (EGA). You can set up the map, satellite, and footprint in contrasting colors on a higher resolution screen for a more pleasing map display.

QUIKTRAK Version 2.1: This is the latest version of the original N4HY QUIKTRAK program for the IBM-PC. Its functions and features are the same as described above. There are no graphics.

The Commodore Computer

C-64 SUPERTRACK is a combination of N4HY QUIKTRAK for the C-64 and a real-time graphics program called MAPTRAK. The entire package was written and assembled by N4HY. MAPTRAK will track up to eight satellites at a time on a world map similar to the ORBITS 2 map. A novel method correlates the numeric data for each satellite with its position on the map. Angle track data for the number one satellite goes to the Game Port and can be used by a suitable hardware interface to the antenna rotors (the original interface for KenPro Rotors may still be available from some distributors).

GROUNDTRACK is a third operational mode which plots the predicted satellite groundtrack on the graphics map of the world. MAPTRAK and GROUNDTRACK share the same Keplerian and QTH data files in QUIKTRAK so that QUIKTRAK's file handlers can support all three programs. This program will also run on the C-128 in its C-64 mode.

C-128 ORBITS is a program specifically written to take advantage of the unique capabilities of the C-128. ORBITS uses time-based incrementing with user-selected increments. This results in uniform time increments between data lines. The ORBITS program features automatic page formatting and pagination. As many as 20 satellites may be entered into Keplerian files. It requires an 80 column monitor and a Commodore compatible printer.

The Apple Computer

Apple QUIKTRAK, Ken Knudson W5PLN's translation of the IBM-PC version of QUIKTRAK, supports all IBM features. You need an 80 column card. Due to the large variation in Apple hardware and accessories, there may still be some incompatible combinations. However, the program runs on most II+, IIe, IIc, and IIGS computers if they have at least 64K of memory, the 80 column card, and a compatible printer. Use of a parallel printer interface in the IIc has caused some trouble.

Apple W3IWI: Dr. Bill McCaa K0RZ did this translation of the original W3IWI program for the Apples still out there with limited memory and no 80 column cards. It supports all original W3IWI features. Larry Papke WB5MPU has contributed a good Keplerian data file handler.

K0RZ Auto-Track

Originally written for circular orbit satellites, this program was one of the first automatic station and antenna control programs available through AMSAT. A more recent version, based on the W3IWI program, is also available. These programs were written for specific clock and A/D-D/A hardware from Mountain Computers. The hardware may be hard to get now, and originally it was somewhat expensive. The complete setup was described in *ORBIT* magazine, Number 11, July/August 1982. A reprint of this information comes with the program.

The Radio Shack TRS-80

Bob Rogers W8JLE accomplished a translation the IBM-PC's QUIKTRAK for Model 4.

Straight translations of the W3IWI program for Models 1, 3, and the Color Computer versions of the original W3IWI program are available. Credit for the translations should go to W0CY, N5AHD, W8JLE, and others.

AUTO-TRACK for the Model 100 is a real-time, dedicated antenna controller, inspired by the WB5IPM Antenna Control Interface described in the May and June 1987 issues of *QEX*. N9HR and W8JLE generated this real-time version of the W3IWI program to supply the data to the interface. The program computes data for six satellites.

HP-41 Programmable Calculator

Both of the following versions were adapted from the original W3IWI program by Roy Welch W0SL.

ORBIT I: This program will output Azimuth and Elevation in real-time, or all W3IWI parameters in the prediction mode. Special requirements are: HP-41C plus a QUAD memory, or an HP-41CV or HP-41CX. A card reader is desirable but not essential for program entry. The program is slow but accurate, and makes an excellent primary or back-up program in a very portable package.

ORBIT II: This program is the same as ORBIT I with the addition of functions from the Time Module for input of Date and Time for the real-time mode. The Time Module is an optional plug-in module for the HP-41C and the HP-41CV. The HP-41CX has the Time Module installed internally as part of the calculator.

Atari, Texas Instruments, and CP/M Machines

Atari Models 400, 800, and other 8-bit Models: W8JLE's son translated the original W3IWI program for the 8-bit ATARI models. Of the two versions available, one runs with Atari BASIC and the other with M BASIC. The translations support all W3IWI features.

Texas Instruments TI99/4A: Original W3IWI program translated for the TI99/4A, with all W3IWI features supported.

CP/M Machines. Roger Ley WA9PZL translated the original QUIKTRAK program for CP/M machines, such as the XEROX 820, KAYPRO, and Heath H-89. A universal format program will work with most CP/M machines. Please specify format and machine. You can use all features of the original QUIKTRAK.

Needed: New Authors and Volunteers

See the table for the AMSAT Software Exchange's current offerings. Other software may be available on special order. Please inquire if your computer isn't listed. New programs are always being contributed to the exchange.

New computers come on the market, and old ones become obsolete. AMSAT Software Exchange is constantly in need of authors/translators. For example, the Apple II series is probably the most widely used computer in the schools of the world. A good program for the Apple, combining most of the features of QUIKTRAK, and a basic graphics program such as MAPTRAK, would be very desirable. Also, as another example, the TRS-80 Color Computer could use a software update.

We badly need volunteers to keep programs, literature, and distribution copies up to date on several of the older W3IWI versions. If we can't find people to do these tasks, we will have to drop these programs from the AMSAT Software Exchange.

Obtaining AMSAT Software

A list of current programs, along with recommended donations and ordering instructions, may be obtained from *AMSAT SOFTWARE EXCHANGE, PO Box 27, Washington, DC 20044.*

The popular programs are available from an AMSAT booth at many hamfests, along with instructions and demonstrations, and from your local AMSAT Area Coordinator.

I hope you have found this review helpful in selecting a satellite prediction/tracking program to fit your needs. If I have made any errors or oversights in reviewing the above software, or if I have failed to give credit to anyone, please let me know.

QUIKTRAK 4.0 and TRS-80 Model 100 AUTO-TRACK will be in distribution by the time you read this article. There may be some minor changes to these programs as they are completed. See you on the birds! 73

73 Review by *Bob Kosa N5LCO*

Automatic Antenna Tracking with SAT TRAK III

Dedicated hardware antenna tracking controller.

SAT TRAK III
Applied Digital Research, Inc.
PO Box 10184
Sarasota, FL 34232
Phone: (813) 378-3410
Price Class: $300 and $350

Photo A. The front...

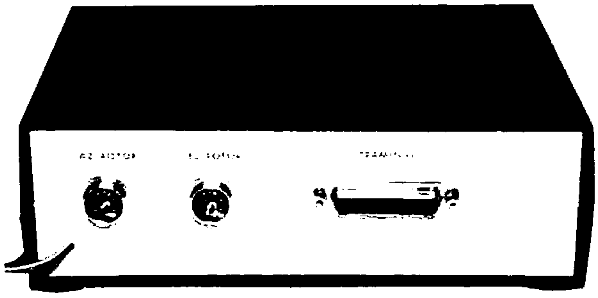


Photo B....and the back panel of the SAT TRAK II controller. Note the minimum of controls.

If a group of satellite chasers were to pool their ideas into one wish list and build a controller based on those ideas, they would have the SAT TRAK III. SAT TRAK III, manufactured by Applied Digital Research, Inc., is a microprocessor-controlled automatic satellite antenna rotor controller. At last! No more paging through computer printouts of tracking information, or fumbling with the buttons on the rotor controller! Thanks to SAT TRAK III, making contacts on low orbit satellites is easy—you can concentrate totally on making the QSO.

Features

SAT TRAK III is easily interfaced to several major brands of rotors. Operation is simple, smooth, and accurate. A detailed manual and user friendly software quickly guide a new owner through the installation.

The tracking software, battery backed-up system clock, and memory, microprocessor, and relay control circuits are all assembled on one printed circuit board. To track a satellite, all you need to do is change the twelve-position rotary switch mounted on the front panel. A flashing LED indicates tracking status (satellite-above-horizon).

SAT TRAK III does not need to be connected to an external computer while tracking a satellite. You can use an RS-232 or a TTL level compatible dumb terminal to initialize the system, then disconnect the terminal from the controller until it is time to enter new Keplerian element sets.

SAT TRAK Chassis

SAT TRAK III is housed in a compact plastic box which measures 8" x 6.25" x 2.5". [This is just the right size to place underneath my Kenpro KR-5400 El-Az (elevation-azimuth) dual controller.] The inside of this box has been sprayed with a conductive coating to prevent interference to adjacent equipment in the ham shack (probably a requirement for the FCC Class B computing device certification). As a precautionary measure, I checked for interference with modes A (2 meters up, 10 meters down), B (70 cm up, 2 meters down) and J (2 meters up, 70 cm down) and did not encounter any problems. Yet, even with the excellent RFI shielding, I would still prefer a metallic box.

> ***"To adjust the voltages to levels within range of the A/D, tweak the two trim pots on the printed circuit board. This is the only hardware adjustment required by SAT TRAK III."***

Inside of SAT TRAK III is an innovative printed circuit board whose brain is an Intel 8052AH microprocessor with a BASIC interpreter. The tracking program is kept as "firmware" in a 16 Kb EPROM. This circuit board also has an accurate Timekeeper™ clock chip with 2 Kb RAM and an integral lithium battery. The station and satellite data, maintained in 8 Kb of RAM, rely on the clock battery to prevent memory loss. This battery is said to have an approximate life span of ten years under normal conditions. An 8-bit analog-to-digital converter samples the rotor potentiometer feedback voltages (stall sensor), the SATELLITE SELECT switch, and the TRACK ENABLE switch.

Five triacs mounted vertically on the board control elevation "up/down", azimuth "left/right", and azimuth braking. Adjacent to each of the triacs is a red LED which is used primarily as a troubleshooting aid for any hardware problems. Mounting the LED's on the front panel may cause unnecessary clutter, but, on the other hand, it gives the user a better understanding of the status of the tracker.

Another very handy feature is an amber

LED which is mounted above the tracking switch. This LED will blink "on" once every 6 seconds when the satellite being tracked is below the horizon. Conversely, it will blink "off" once every 6 seconds when the satellite is above the horizon. If you like bells and whistles (in the truest sense), Applied Digital Research has provided schematics for three simple add-on alarm circuits which may be used to indicate satellite-above-horizon status.

Set Up

To install the unit, first connect an RS-232 extension cable from the DB25 socket on the back of the tracker to a serial port on a computer or terminal (see the "Features" section above). Applied Digital Research supplies a small AC/DC adapter with the tracker. Plug this into the wall. The communications software should be set to 8 bits, no parity; or 7 bits, even or odd parity; one stop bit and 4800 baud. The baud rate may be changed at a later time. When SAT TRAK power is turned on, tracking automatically begins within seconds. Entering a cr> (carriage return or the enter key) will let you leave the tracking mode and return to the main menu.

> ***"The SAT TRAK III is an innovative and intelligent stand-alone automated antenna tracking controller."***

The first time that the tracker is turned on, you will have to set the system clock by choosing the "CLOCK SETUP" command option and synchronizing the battery backed-up clock with WWV. This clock should be accurate to within a few seconds over the period of a month. If any deviation does occur it may be compensated for in the "CALIBRATE" function of the CLOCK SETUP option.

Station Setup

To set up the station, you must make two cables to connect the rotor controller box to the interface of SAT TRAK III. Each cable should consist of an 8-pin mike plug and a 5-conductor shielded cable. The manual contains wiring diagrams for the Kenpro/Yaesu KR-5400 A/B, KR-400, KR-500 and CDE type rotors. Older Kenpro rotors, like the KR-5400, will require a minor modification by running a wire from the 26-volt AC tap of the transformer (switch common) to the back of the controller box. Connect the rest of the wires in parallel to the lines on the terminal boards on the back of the Kenpro El-Az controller box.

Calibration

Next, you must calibrate the unit. This is a vital part of the installation setup because it enables the microprocessor to equate the rotor feedback voltages to the azimuth and elevation angles (degrees). Before you turn on the power to calibrate SAT TRAK III for any rotor combination, make sure that the tracking switch is in the "disable" position. This prevents erroneous movement of the rotor to positions which might damage the antennas or coax.

Any time the power is turned on, SAT TRAK will automatically return to the tracking mode. The screen output contains all the pertinent tracking information (see Figure 2). The microprocessor performs El-Az coordinate calculations on approximately six second intervals. Simply entering a cr> will return the program to the main menu "COMMAND OPTIONS". From there, choose "TEST ROUTINES".

There are two functions within the TEST ROUTINES: "ROTOR FEEDBACK VOLT METER", and "MANUAL POSITION CONTROL". If you choose the ROTOR FEEDBACK VOLT METER function, SAT TRAK will display the voltages seen by the A/D for both azimuth and elevation. To adjust the voltages to levels within range of the A/D, tweak the two trim pots on the printed circuit board. This is the only hardware adjustment required by SAT TRAK III. Next, to establish some validity to the calculations performed by the micro, you must return to the main COMMAND OPTIONS menu and from there choose the "SETUP AND STATION DATA" option. (Figure 3, reproduced from the manual, illustrates the simple and precise path of the software.) After entering the station latitude, longitude and elevation, SAT TRAK begins to ask several other questions, such as "ACTIVATE ANTENNA FLIP?" and "AZIMUTH ROTOR STOP AT NORTH OR SOUTH?" in order to determine the exact configuration of the rotors in the station.

After you have determined the physical configuration, you must calibrate the system by recording the voltages at the minimum and maximum meter readings. The microprocessor samples the rotor pot feedback voltages and stores them as calibration data in the random access memory. The final question in the setup option is "CHANGE BAUD RATE?" No

COMMAND OPTIONS

1 = RUN SATELLITE TRACKER
2 = LIST/UPDATE SATELLITE DATA
3 = CLOCK SETUP
4 = SETUP AND STATION DATA
5 = TEST ROUTINES

SELECT COMMAND 1–5 ?

Figure 1. Main Menu Command Options

TRACKING DATA FOR SATELLITE #3 = RS-10/11
(hit cr> to go to setup menu)

AZ	EL	RANGE	HEIGHT	LAT	LON	PHASE	DOPPLER	TIME
198	1	3495	989	2.6	104.3	205	0	21 : 10 : 19
198	2	3421	989	3.3	104.2	206	561	21 : 10 : 30
199	2	3384	989	3.6	104.2	206	600	21 : 10 : 36
199	3	3348	989	3.9	104.2	206	596	21 : 10 : 43
199	3	3311	989	4.3	104.2	207	599	21 : 10 : 49
199	4	3274	989	4.6	104.2	207	608	21 : 10 : 55
199	4	3237	989	5.0	104.1	207	598	21 : 11 : 1
200	4	3195	988	5.4	104.1	207	585	21 : 11 : 7
200	5	3158	988	5.7	104.1	208	596	21 : 11 : 13

Figure 2. Tracking Data Display

DATA FOR SATELLITE 3 = RS-10/11

MEAN MOTION (ORBITS/DAY)	13.719267
MEAN ANOMALY (DEG)	220.6177
INCLINATION (DEG)	82.9264
ARG PERIGEE (DEG)	139.5954
RAAN (DEG)	358.7229
EPOCH YEAR (YY)	89
EPOCH DAY AND FRACTION	4.9602995
ECCENTRICITY	1.2783 E-3
DECAY (ORBITS/DAY^2)	2.64 E-6
BEACON FREQUENCY (MHZ)	29.407

Table 1. Typical Keplerian Element Data

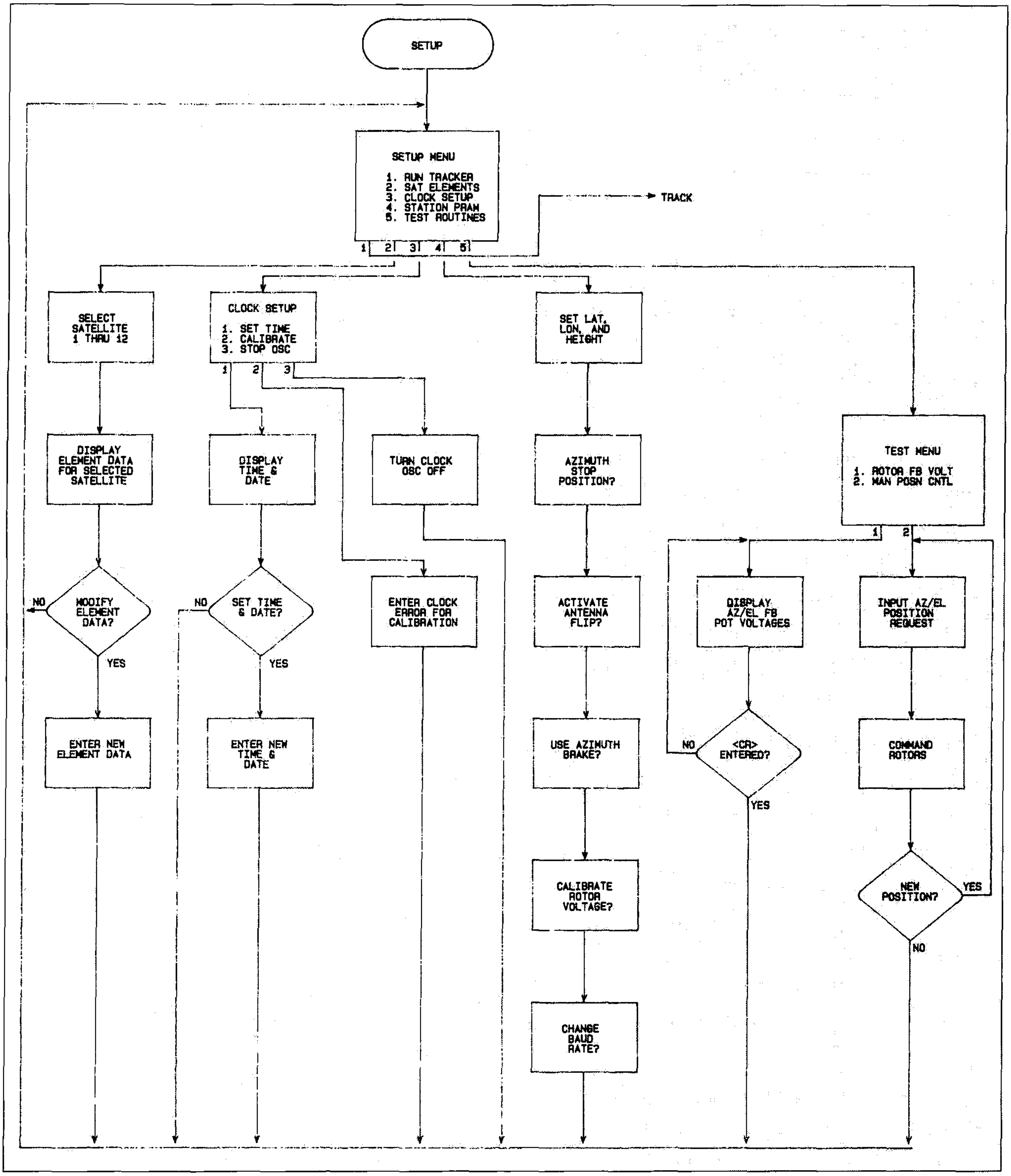


Figure 3. Flow chart for tracker setup and station data.

thanks, 4800 baud should be fast enough.

Now you must add some credibility to the tracking data. Return to the main menu and choose the "LIST/UPDATE SATELLITE DATA" option. This will display a list of satellite-select switch positions, and the corresponding satellite names. The tracking algorithm uses Keplerian element data (see Table), sets consisting of strange numbers with even stranger names like "Mean Motion", "Mean Anomaly", "Inclination", and "Epoch Day", to name but just a few. You can get the background information that you need on several computer bulletin boards, in AMSAT news letters, and from NASA. Then, simply select the satellites of choice and enter the new values when prompted.

Ready to Track

Is SAT TRAK calculating valid El-Az data? A quick comparison with AMSAT's QUIK-

TRAK, by Bob McGwier N4HY, reveals that it is right on target. This software is fast, accurate, and as near to real time as can be expected. No leap year bug to worry about, either. Very impressive!

On-the-Air Test

A quick flip of the tracking switch enables automatic rotor control. I had the satellite select switch set for RS-10. The Kenpro El-Az meters indicated that the beams were swinging into position. Time to play! CW from the RS-10 robot came in at around 29.407 MHz. With very little effort I logged 12 QSOs with the RS-10 robot, peaking at, but not breaking, the 55 wpm barrier. Finally, I was able to concentrate on making the contacts. No longer do I have to fumble with up/down, left/right buttons!

How smoothly do the antennas move? Both the azimuth and elevation rotors can be commanded to move at the same time. I wanted to watch the antennas move so I waited for the next satellite pass and this time, like a devoted ham, I stood outside in the rain to watch. I did notice that the azimuth and elevation were not typically commanded to move at the same time, but movement was still smooth and precise.

As a further test, I went back inside to try the test routine "MANUAL POSITION CONTROL" option. Commanding the rotors to move from one extreme to the other gave me plenty of time to run outside and watch the antennas move. Once again, the antennas drew a smooth arc across the sky. Just out of curiosity, I turned the tracker off and on several times. The antennas were not commanded to swing around wildly to a random position on power-up. Instead, they did not move until a set of El-Az coordinates were calculated for the current system clock time and sent to the rotor controller.

When the SAT TRAK interface power is off, the rotors may be controlled in the normal manner. The only problem that I found with this controller is that when the SAT TRAK III power is off, there is a voltage offset equivalent to 45 degrees at full-scale azimuth and 2 degrees at full scale elevation. This occurs because the rotor feedback voltages are pulled down when the tracker power is off. Apparently, some current flows back up to the power supply through two diodes when power to the tracker is off. This annoyance may be avoided by simply turning both units on when positioning the antennas manually.

"At last! No more paging through computer printouts of tracking information, or fumbling with the buttons on the rotor controller!"

Summary

The SAT TRAK III is an innovative and intelligent stand-alone automated antenna tracking controller. With retail prices at $299 for the model which interfaces to Kenpro/Yaesu KR-5400 A/B rotors, and $349 for the model which interfaces to most other rotors, you will have a microprocessor-controlled state-of-the-art tracking system. This device will not tie up an expansion slot in your computer, nor will it require a dedicated serial or parallel port. The hands-off operation of SAT TRAK III makes it an ideal candidate for GATEWAY stations, and for all avid satellite chasers.

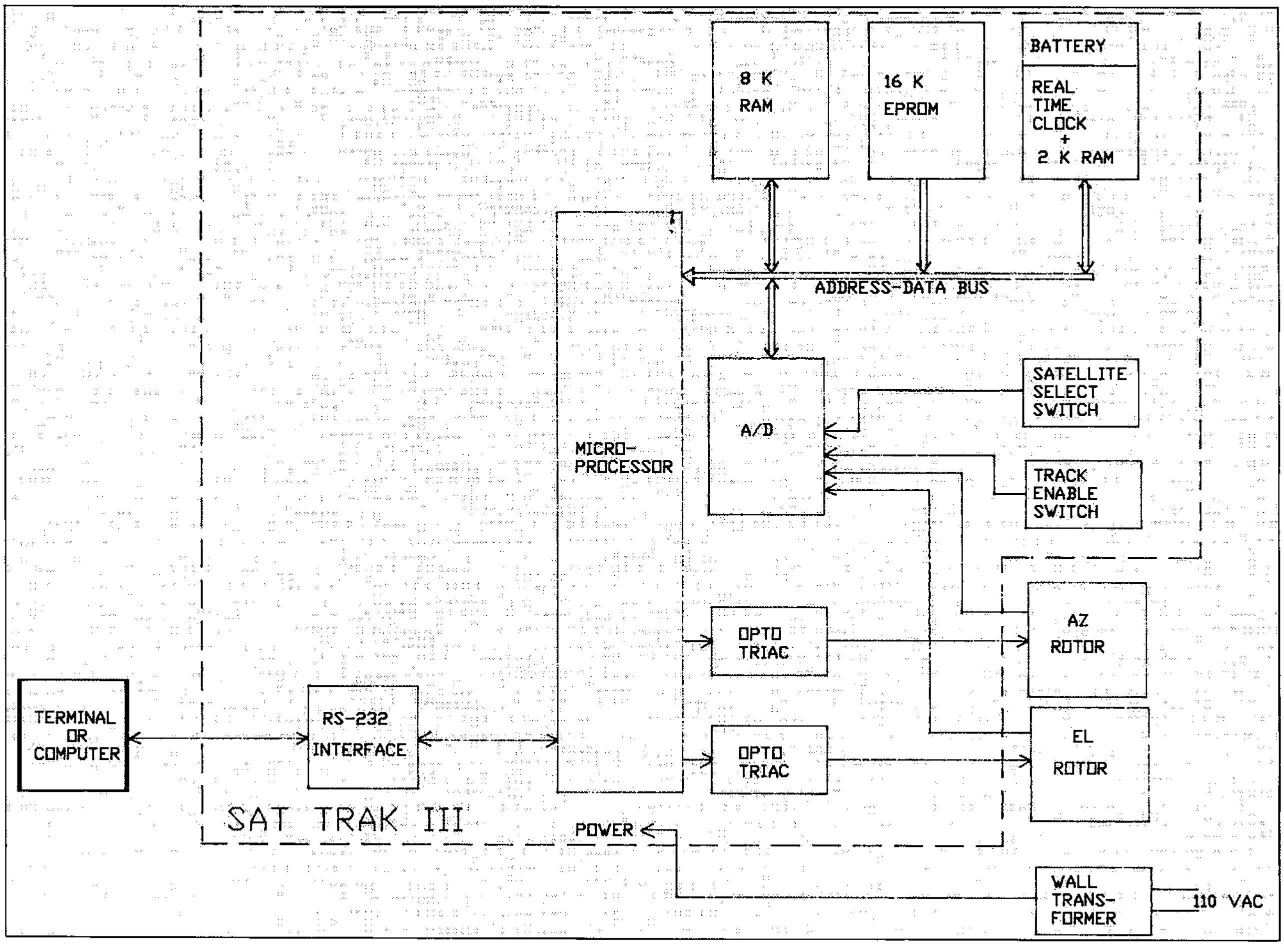


Figure 4. Block diagram of the SAT TRAK III controller.

Mode L, My Way

Clever way to reduce line loss for the 1269 MHz uplink.

by Ralph E. Herzler WA8WBP

Several years ago, I was bitten by the satellite bug, and I have enjoyed satellite operation ever since. It is more challenging than 2 meters or the "low bands." After a start on Mode B (435 MHz uplink and 145 MHz downlink), I gained confidence in 435 MHz operation. It works very well, but I discovered that line losses begin to really matter at high frequencies.

Moving to Mode J operation Mode B was easy—just reverse the uplink and the downlink for the bands. I needed only to install a preamp in the 435 section of the antenna array, since that's the band I now received on.

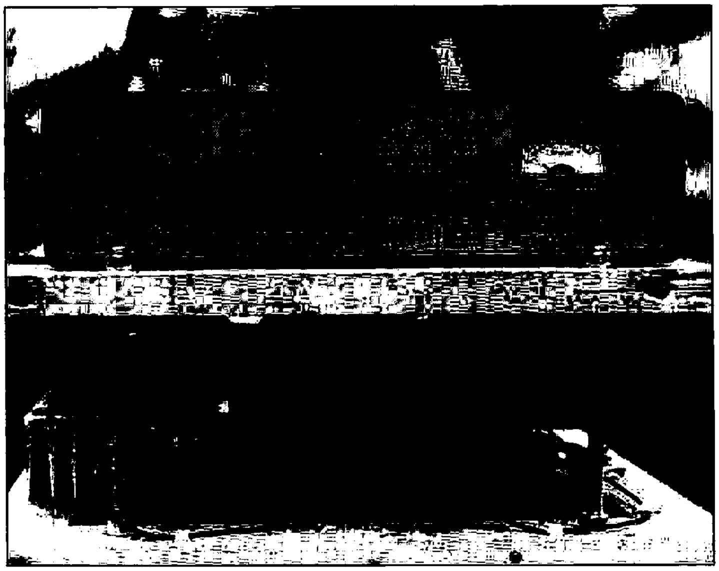


Photo A. Front view of 1269 MHz converter, capacitor, and linear amplifier. The amp, available from Downeast Microwave, converts 10 Watts of drive to 35 Watts of output.

One Mode led to another...soon I learned that Mode J is applicable to a subband segment of the total Mode JL spectrum. Curiosity led me to listen in on the Mode L segment, which is several times wider than the Mode J portion.

Mode L was again a whole different realm. In this mode, the downlink is still on 70cm, but the uplink is on 1.2 GHz band! I was now in the microwave region, which to me seemed a tricky operation with high transmission line losses, vacuum tubes with high anode voltages, and (horrors) water cooling in direct contact with high voltage. I thought there had to be a better way, and that is what this article is about!

Search for Less Line Loss

I listened to these resourceful Mode L operators, and gathered a lot of basic information. I even wrote to Fred Crowedeaux WD5GQM to find out how he developed such a fine Mode L signal, and I learned that he had done some basic work with feedline losses. At his installation, 12 Watts of 1269 energy had dropped to 4 Watts through 55 feet of Belden 9913. He resolved this by using hard line in place of 9913. According to the *ARRL Handbook*, however, even the best hard line loses over 2 dB per hundred feet at over 1 GHz.

According to AMSAT, in the *Amateur Satellite Report* (August 22, 1988), you should shoot for 30 Watts applied to a 20 dBi antenna array in order to have good SSB contacts "under most conditions." Since I am 100 feet away from my antenna, I would need at least 60 Watts of 1269 energy in my shack, and 100 feet of ⅞" hard line to do the job. Hard line that size is about four dollars per foot. Type N fittings are $55 each. Thus, the transmission line system alone would run over $500, and I was still dealing with very high output power on 1.2 GHz. There had to be a better way!

> *"...even the best hard line loses over 2 dB per hundred feet at over 1 GHz."*

The Solution

After some nights of light sleeping, the answer came to me—I would convert a 2 meter signal to 1269 MHz at the antenna to avoid the line losses that result if you do this conversion in the shack. Obviously, this was not a complete answer because, with the antenna I had in mind, I still had to develop about 35 Watts to do the job. It did have merit, though, since Modes J and L both use 435 MHz for a downlink, leaving the 2 meter signal available for this project.

For satellite operation, I use the ICOM 271A and 471A connected to the ICOM CT-16 interface for the transceiving system. For tracking the birds, I use the N4HY program interfaced to the Kenpro 5400A rotor control via my trusty Commodore 64.

Antennas

My antennas are the KLM 40CX and the Cushcraft A144-20T, plus my home-brew helix for 1269. The 1269 helix was designed from data published in the fourth edition of the *RSGB VHF/UHF Manual*, with modifications. Table 12 of this publication suggested a spiral of ¼-⅛" tubing wound at three inches diameter. Because I had a random length of ¼" aluminum tubing, I wound it over a form to produce three inches OD, and found that I had 12 turns. According to the table, this would produce a gain of 16 dB.

Next, I needed to devise a method of supporting the helix. The usual center support with helical "spikes" looked flimsy. Why not support it externally? I used three pieces of 1½" x ½" nylon, notched to accept the helix. The helix is tied to the nylon supports with 20-pound fishing line and anchored with epoxy cement. The reflector is a piece of aluminum sheet 7" in diameter, sawed from the bottom of an old frying pan. There is nothing magic about these materials. I had the

tubing and an old frying pan, and my nearest Cadillac Plastics outlet had the nylon.

Impedance Matching

The *VHF/UHF Handbook* suggested using a quarter-wave matching transformer for the helix antenna since its characteristic impedance was 140Ω. I did not really like this approach, and I was bemoaning this fact in a QSO with Wally Nelson W7KRC, when he remembered an article in the June 1981 *QST* describing a better way to attain a 50Ω feedpoint. Instead of terminating the helix at the center of the reflector, you terminate it along its periphery, with the last several inches flattened parallel to the reflector. Then you adjust the impedance for minimum SWR by changing the distance between the flattened section and the reflector. Much more desirable! I tried it and it worked. This funny looking contraption was supposed to have enough gain for my purpose.

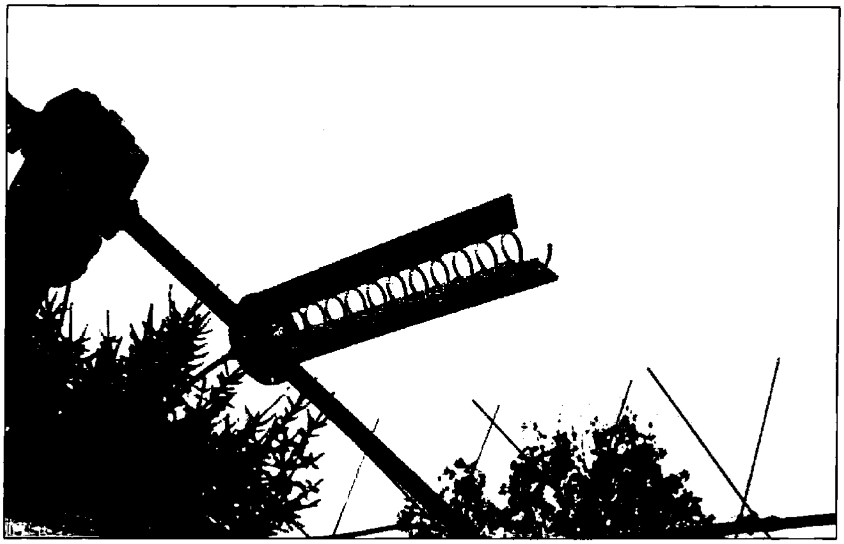


Photo B. The home-brew 1269 MHz helix antenna. Plans for it came out of the RSGB VHF/UHF Handbook. The reflector was cut from the aluminum bottom of an old frying pan.

The Power Amplifier

Research led me to believe that power levels above 10 Watts at 1269 MHz weren't possible with solid-state devices, simply because appropriate transistors did not exist. I guess no one had told Bill Olson W3HQT at Downeast Microwave about this. He offered a very nice amplifier that develops 10 Watts of drive to a little better than 35 Watts. That beat running a 120 volt line to the antenna and developing a typical high voltage vacuum tube amplifier. My tower is only eight feet high, but, still, I didn't want to fool with a thousand volts while standing on a step ladder.

The Transmit Converter

For this, I first contacted Transverters Unlimited. They only carried full transverters, and I didn't need the receive portion, nor did I want to chance problems with the transmit/receive switching in such a unit. Bob Morton NI1W, who represents Transverters Unlimited in the US, advised me that SSB in West Germany was about to bring out their LT24S transmit converter that would do the job I wanted.

I ordered one, and after some weeks it finally arrived, complete with instructions in German! The local high school German instructor translated the instructions literally, which I then had to re-translate into meaningful directions. Suddenly, I learned that this unit was designed for 14.5 volt DC power with a 13 volt minimum requirement. So much for using my solar charged storage battery. It had to be the full 13.8 volts from my heavy duty station supply, and that meant burying a heavy conductor in December in Michigan. I used a stranded #8 wire for the positive conductor. The negative return was carried on the tower legs and on the aluminum sheath of two lengths of hard line through various interconnections.

Getting Underway

I used a 12 volt Dow-Key relay to switch my 2 meter RF from its normal path, to a 2 meter antenna to the new converter and to provide 13.8 volts to the new devices. The relay is activated by a small switch in the shack which sends the control voltage to the tower on a spare wire in the rotor cable.

Next, as my wife whistled into the mike, I set my 271A for minimum RF out, and adjusted the converter to show full 10 Watts out to a dummy load and 2-4 Watts on normal voice peaks. I then installed the 12" x 14" x 9½" open-bottomed cover over the equipment and got on the air.

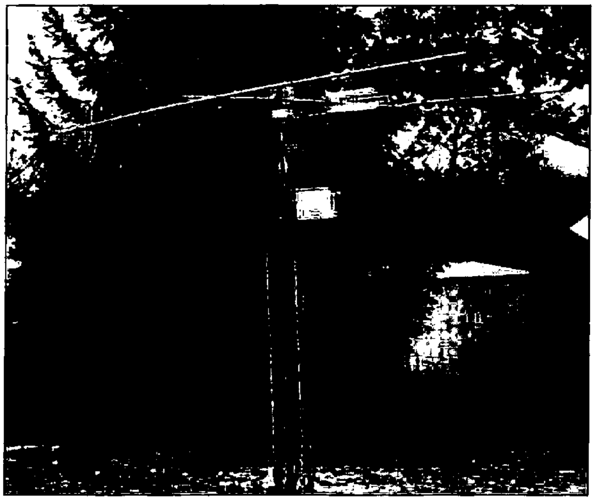


Photo C. The Mode-L antenna array. The gray box under the antenna is the weatherproof container for the 2m/1269 MHz converter and linear amp.

Proof Of The Pudding

A ham was calling CQ on Mode L. My signal was strong enough, but it sure didn't sound good. The following day, I rechecked the input level on the converter and found it right where I had set it. Then, on a hunch, I checked the DC voltage while my bride whistled and talked again. The DC was modulating right with her input, so I went to work and cleaned up my DC negative return line. This seemed to correct the problem, but since I had a 42,000 μF capacitor on hand, I placed it across the 12 volt line for insurance. Viola! Success!

Finale

Many may wonder about operating this electronic jewelry out in the weather. I built a galvanized steel box, open at the bottom for cooling, and used soldered lap seam construction. It is secured to the wooden equipment rack with half a dozen wood screws. There is easy access for coax and power lines, adequate cooling, and weather security; the latter because the "skirt" of the box extends well below the equipment.

Having a Mode L system that works is a fine reward in itself. Even more of a reward is having a truly unique approach, and telling other Mode L operators about it. My transmission line from the power amplifier to the antenna is five feet of Belden 9913. From the reports I get, the loss there is acceptable! I really hope that one of the manufacturers will latch onto this scheme and offer a helical antenna integral with (no transmission line) a converter and an amplifier—the ultimate suggestion by my good friend, Bob Machan WA8L.

I hope you will enjoy putting together this Mode-L station—without having to spend a bundle on hard line and microwave power amps!

Polarizing/Matching Selector

Choose your phase.

by Gerald Klatzko ZS6BTD

During line-of-sight (LOS) communication, which is the case with satellite communication, maximum signal transfer will occur when the antennas at both ends of the circuit have the same polarity. This doesn't apply to HF communication because polarization is lost after the elĕctro-magnetic waves have passed through the ionosphere.

The polarity of the antenna is decided by its position with respect to mother Earth. This position also defines the polarity of the electric field parallel to the axis of the radiation.

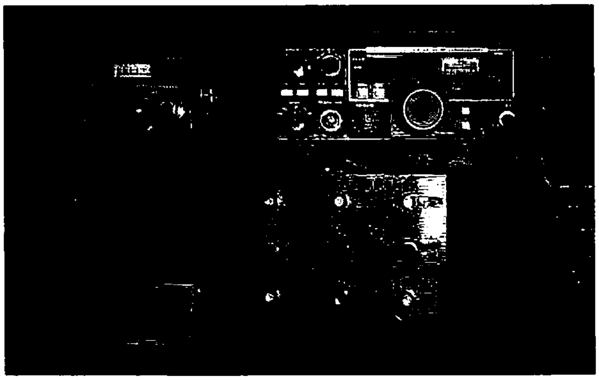


Photo A. Front panel of the polarizing angle-matching selector.

Matching Polarity

An antenna perpendicular to Earth is vertically polarized, and one parallel to earth is horizontally polarized. Cross-polarization between the transmitting and receiving antennas results in extreme reduction of signal strength, approximately 20 to 30 dB, or a reduction of from 100 to 1000 times. For a strong signal it's essential that, on both transmit and receive, the polarity of the ground station's antenna and the polarity of the satellite's antenna match.

Unfortunately, the satellite continuously varies its attitude with respect to the ground station. To maintain polarity, we have to create a facility at the ground station to vary our antenna polarization from vertical to horizontal, to RH circular, to LH circular, to 45 degrees linear, and to 135 degrees linear.

Experimenting with Antenna Systems

Talking to satellite operators around the world, and asking each one what type of antenna he uses and what he does about polarization, we have heard some weird and wonderful tales of typical amateur ingenuity and resourcefulness.

The most ingenious is Rex of Ruislip G4JUJ, who has mounted two yagis side by side, about 1 wavelength apart, with each boom axially rotated by individual motors. While Rex is listening to a received signal, he adjusts the angle between the two yagis until he gets the best possible signal. From his experience on OSCAR 10, he knows approximately where to set the two positions.

We found proponents of vertically polarized antennas, horizontally polarized antennas, and circularly polarized antennas. Each proponent will tell you that his system gives the best results—after all, he built it or bought it and he gets excellent results with it, so surely it must be the best.

The Proof of the Pudding...

Now the little nagging doubt sets in—they all have different systems and they all claim to be right. Which one do you accept? Which one will give you the best results? The only way to find out is to "suck it and see!" as we say in South Africa. But how?

I could not get geared-down motors and

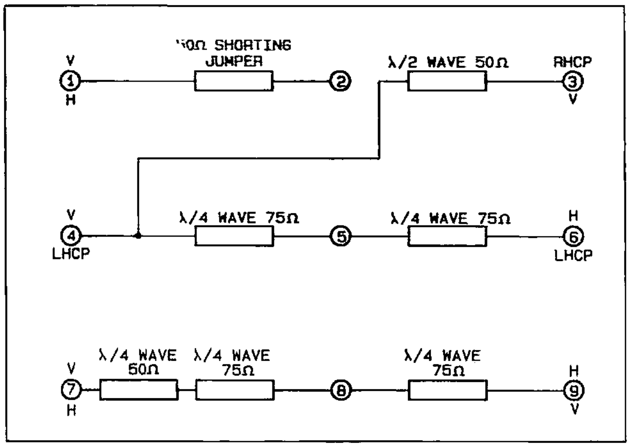


Figure 1. This unit is designed for 70 cm. BNCs are 50 ohm. The coax is positioned as close as possible to the BNC.

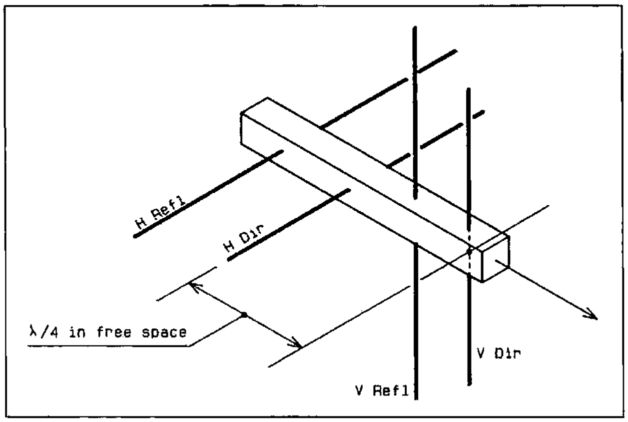


Figure 2. A crossed yagi antenna that consists of two dipoles at right angles to each other. The arrow to the right of V Dir shows the direction of maximum gain.

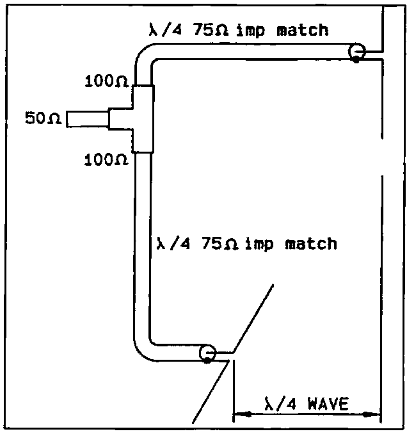


Figure 3. The TX line plugs into BNC(5). BNC(5) is joined to BNC(4) and BNC(6) by ¼-wave, 72 ohm impedance matching lines.

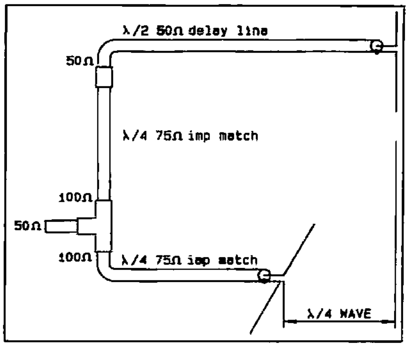


Figure 4. The TX line remains in BNC(5). However, the vertical antenna now plugs into BNC(3), in order to insert the ½-wave, 50 ohm delay line. The horizontal antenna remains in BNC(6).

special bearings to fit the available booms, and I didn't relish making rotation indicators to show the axial angle. Neither could I get the extra low-loss, high-Q special switching coaxial relays to mount up at the antennas to do the change-over switching. However, I still wanted a system with which I could test the effects of various antenna polarizations for myself. I decided to use 18 BNC sockets mounted on a panel, with the sockets selectable by means of three fly-leads to simulate the three wiper-arms shown in the book: one fly-lead from the transceiver, one from the vertical antenna, and one from the horizontal antenna.

By repositioning the two antenna fly-leads, I could easily change the antenna polarization. This enabled me to halve the number of BNCs to 9. I now had a simply-built, inexpensive unit that met all the requirements to carry out the comparisons of the various polarizations.

The unit in Figure 1 is designed for 70 cm. The BNCs are 50 ohm chassis-mounting types. A copper foil skirt is pop-rivetted to one corner of the BNC, then wrapped around the shield of the coax. Position the coax as close as possible to the BNC in order to maintain a constant 50 ohm impedance. You can easily check the impedance by leaving a VSWR meter connected in-line while transmitting low power through the polarizing unit. Adjust the wrapping of the skirt to obtain the lowest VSWR. Copper foil is also used to join shield-to-shield of the delay/matching line between terminals 7 and 8.

I measured the velocity factor of the coax with a dip oscillator at 146 MHz (because I do not have a 438 MHz dip oscillator) to establish a ½-wavelength. Then I cut this in three to get the correct ½-wave at 438 MHz, and in ½ again for the ¼-wave line.

The Six Positions

P1 = VERTICAL: The very short jumper (approx. 85 mm), joins TX BNC(2) to BNC(1). The fly-lead from the vertical antenna is connected to BNC(1).

P2 = HORIZONTAL: As P1 above, but now the fly-lead from the horizontal antenna is connected to BNC(1).

P3 = LHCP: The TX plugs into BNC(5). BNC(5) is joined to BNC(4) and BNC(6) by ¼-wave, 72 ohm impedance matching lines only. See Figure 3.

P4 = RHCP: The TX remains in BNC(5). However, the vertical antenna now plugs into BNC(3) so that you can insert the ½-wave, 50 ohm delay line, as in Figure 4. The horizontal antenna remains in BNC(6).

P5 = 45-degree LINEAR POLARIZATION: The TX plugs into BNC(8). The horizontal antenna plugs into BNC(9) to connect to the 72 ohm, ¼-wave matching line, and the vertical antenna plugs into BNC(7) to connect to the ¼-wave 50 ohm delay line in series with the ¼-wave 72 ohm matching line.

P6 = 135-degree LINEAR POLARIZATION: The TX remains in BNC(8), but the vertical and horizontal antenna fly-lead positions are opposite the P5 positions.

Circular Polarization

What is circular polarization? It is where the polarization of a signal is constantly rotating about its axis. You can achieve this with the crossed yagi configuration when the horizontal and vertical yagis emit the same signal 90° out of phase (recall that this can be done with the yagi elements physically spaced 1/4 wavelength apart and fed in phase, or with the elements physically spaced in phase, but fed 1/4 wavelength apart). Circular polarization is compatible, with no more than a 3-dB power loss with either vertical or horizontal polarization.

A circularly polarized antenna system is the most useful single configuration to have for satellite work. The antennas on our most popular satellites (A-O-10, A-O-13, F-O-12) are circularly polarized, and the linear antennas on the other birds are always changing their orientation.

With this box, however, you do not have to make do with just one configuration—you've got six to choose from. No more having to put up with much less than the best polarization matching possible! ■

Experimental OSCARs

Extraterrestrial DXing

by Jeff W. Ward G0/K8KA

If you're excited by all this talk of orbits and OSCARs, your trusty 2 meter FM rig or VHF scanner can bring your first QSL from space! Three times each morning, and three times again each evening, UoSAT-OSCAR-9 and UoSAT-OSCAR-11 come within range of your shack. Simply break away from your favorite 2 meter repeater (interrupting the inevitable discussions of local weather and traffic patterns), tune to 145.825 MHz, and wait. Sometime between 7 and 10 o'clock local time, you'll hear a UoSAT downlink.

Photo A. Roger Peel G8NEF working on an engineering model of the UoSAT-OSCAR-11 on-board computer. Photo by Martin Sweeting G3YJO.

Most of the time the downlink transmits computer data, which sounds like a continuous packet radio transmission, but every few minutes the digital voice of UoSAT will say "73 FROM UoSAT IN SPACE. PLEASE QSL." Send your reception report to UoSAT Headquarters, and you'll receive a satellite QSL card. Even a handheld with a rubber duck antenna can get you this extraterrestrial DX.

UoSAT (pronounced "Ewe-owe-sat") stands for University of Surrey Satellite. Two OSCARS. UoSAT-OSCAR-9 and UoSAT-OSCAR-11, were built by radio amateurs, students, and faculty members at The University of Surrey (UoS), which is in the city of Guildford, in the county of Surrey, England.

AMSAT activities at UoS started in 1974 when Martin Sweeting G3YJO began tracking OSCAR-7 from The University's amateur radio club station. Two years later, this station changed from a normal OSCAR user station to an important AMSAT command center, because OSCAR-6 needed almost continuous care from ground controllers. Yagi antennas on a navy surplus battleship gun mount were linked to the university's main frame computer for automatic tracking. Roger Peel G8NEF programmed this system, which included a punched tape link (remember paper tape?), and helped prolong OSCAR-6's lifetime by preventing deep discharge of the on-board batteries.

The next logical leap for the group at Surrey was to design, build, and command its own OSCAR satellites. It took a lot of negotiation, but by 1979 the appropriate authorities had been persuaded to part with the necessary funds, a launch opportunity had been identified, and the UoSAT-A program was underway.

UoSAT-OSCAR-9

AMSAT planners decided that UoSAT should compliment and not duplicate the AMSAT and Radio Sputnik communications satellites already in orbit and on the drawing board. Thus, UoSAT-OSCAR-9's primary missions were technical experimentation and education, instead of two-way communications.

An orbiting satellite can be a valuable educational and technical tool if it is easy to access and provides interesting information, so UoSAT-OSCAR-9 was fitted with several scientific experiments and an array of data transmission beacons. The experiments include 2.4- and 10-GHz microwave transmitters, a magnetometer which measures the Earth's magnetic field, a Charge-Coupled Device (CCD) camera to take pictures of Earth, Geiger counters to measure radiation in space, and HF propagation beacons on 7, 14, 21, and 28 MHz. Data from these space experiments is available to everyone who monitors UoSAT.

The UoSAT-OSCAR-9 HF beacon experiment can provide your next experience in satellite SWLing. This requires a little more planning than simply waiting for the VHF beacon. Ask a local AMSAT member for some orbit predictions for UoSAT-OSCAR-9, and when it should be in range, listen for CW transmissions on 29.510, 21.002, or 14.002 MHz. Don't forget that the Doppler shift will make the signal frequency seem higher when the satellite is coming toward you and lower when it's going away. The beacon transmits "AMSAT" in Morse code, then unmodulated carrier for signal-strength measurements, then a line of Morse telemetry. The 29 MHz beacon will be the strongest, since it is not attenuated by the ionosphere as much as the lower frequency beacons.

When you've found one of the HF beacons, compare your HF Acquisition Of Signal (AOS) and Loss Of Signal (LOS) times with those for the 2 meter signal. You may find that over-the-horizon propagation makes the HF signals audible longer than the VHF signals. This is just one of the many fascinating areas of AMSAT satellite experimentation.

As well as carrying so many experiments, UoSAT-OSCAR-9 uses several different downlink data formats. Like all AMSAT satellites, it can generate Morse code telemetry (on board voltages, currents, temperatures, and experiment values), but with so much information, it needed faster ways of getting the data down to Earth. ASCII and Baudot RTTY from 50 to 1200 bits per second are available. Since the packet radio revolution of the last few years, we tend take 1200 bits/s amateur radio for granted. In 1980 the micro computer was just finding its way into amateur radio shacks, and UoSAT-OSCAR-9 was the first OSCAR satellite designed for computer reception.

For simpler ground stations, UoSAT-OSCAR-9 carries the digital voice synthesizer (DIGITALKER™) that you can hear on 2 meters. The DIGITALKER has given thousands of school children around the world their first direct experience with satellite communications. A DIGITALKER (this time on UoSAT-OSCAR-11) also helped a joint Canadian-Soviet ski team cross

the Arctic during the spring of 1988. The location of the team was measured by search and rescue satellites, passed on to the university via landline Telex, and then sent by UoSAT-OSCAR-11 DIGITALKER to the skiers on the ice. School children throughout the world followed the progress of the SkiTrek by listening to UoSAT and reading AMSAT-NA educational bulletins from packet radio BBSs.

UoSAT-OSCAR-11: You Want It When?!

The most important and precious part of any AMSAT mission is the launch, so when AMSAT supporters at NASA/DELTA offered a piggy-back launch for a second UoSAT satellite, it was impossible to refuse, even though the launch date was only six months away! In six months, just about enough time to organize the average club Field Day, the UoSAT team would have to design, build, test, rebuild, and prepare an entire satellite for launch.

An international team rose to the challenge. The satellite "bus," which includes the structure, power supplies, on-board computer, telemetry, telecommand, and navigation systems, was designed and built at UoS. In Canada, Stan Kazmiruk VE3JBA and his team tested batteries—temperature cycling them in modified freezers, vibrating them in the back of a station wagon on bumpy roads, and X-raying them at the local dentist's office.

Another North American team involving some 20 people designed and constructed the first digital store-and-forward communications transponder, the Digital Communications Experiment (DCE). With some difficulty, they got a microcomputer with 124K bytes of memory on 3 printed boards into a 1-inch high module box. Many tall tales from the UoSAT-OSCAR-11 campaign cannot be confirmed, but Harold Price NK6K's video tapes show the traditional amateur technique of banging the box in use during hardware debugging at the launch site!

Despite the rapid development necessary to meet the launch deadline, UoSAT-OSCAR-11 was an entirely new satellite. The mission objective was to further the educational, scientific, and experimental aims established by UoSAT-OSCAR-9. On board experiments include three Geiger counters, an electron spectrometer, a micrometeorite detector, a CCD camera, and a 192K byte memory bank for camera images or computer data. In 1983, microcomputers were becoming more common in OSCAR ground stations, so UoSAT-OSCAR-11 designs support computer data links up to 9600 bits/second.

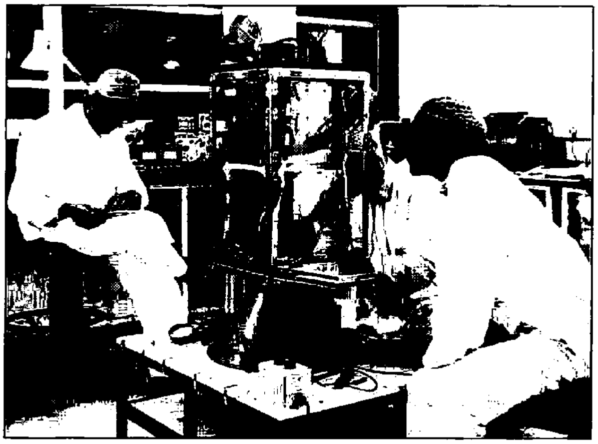


Photo B. Mike Blewett G4VRN (left) and Richard MacBeth G8VLY examine UoSAT-OSCAR-11 in the University of Surrey clean room. The solar panels are removed to permit access to modules and the wiring harness. Photo by Martin Sweeting G3YJO.

Photo C. Spin balance testing UoSAT-OSCAR-11 at British aerospace test facility. Photo by Martin Sweeting G3YJO.

UoSAT-B was launched on March 1, 1984, on a NASA/DELTA launcher from Vandenberg Air Force Base in California, and officially became UoSAT-OSCAR-11 when it was injected into orbit over Turkey. On the first day, the satellite seemed in good health and on board computer programs were loaded, but the next morning UoSAT-OSCAR-11 was silent and would not respond to commands. Nothing was heard for weeks, although the university team kept trying to command the silent satellite.

As a last resort, amateurs from the Stanford Research Institute in California used a dish antenna in Greenland to listen for a local oscillator signal from the satellite's 1.2 GHz receiver. The SRI dish received this 1 μWatt signal, confirming that the satellite was alive and the orbit predictions were correct. Two days later, Neville Bean G8NOB successfully commanded the satellite using a redundant uplink receiver.

The fault which had kept UoSAT-OSCAR-11 silent was isolated to a data carrier detect circuit in the uplink receiver, which kept the satellite from accepting commands. Since the on-board computer and the computer in the DCE could choose to ignore the detect signal, they were used to bypass the failure and UoSAT-OSCAR-11 is now fully operational.

PACSAT Experiments

Unlike UoSAT-OSCAR-9, UoSAT-OSCAR-11 can be used for communications. The Digital Communications Experiment (DCE), built by the North American team mentioned earlier, can receive messages from computers on the ground, store them in on-board RAM, and re-transmit them later in orbit. This is called "store and forward communications."

The DCE was financed by the Volunteers In Technical Assistance (VITA), to test and demonstrate hardware and software for this new technique. AMSAT wanted to build a store-and-forward satellite called PACSAT for amateur radio communications, and VITA wanted to see if store-and-forward communications (on non-amateur frequencies) would help them provide disaster relief and development information to field workers in the Third World. The DCE on UoSAT-OSCAR-11 proved that store-and-forward communications from a small, inexpensive satellite would work, leading the way for the Fuji-OSCAR-12 packet radio mailbox and several advanced digital communications OSCARs now under construction.

Messages sent via the UoSAT-OSCAR-11 DCE must pass through gateway stations, which issue commands to the satellite for storing and reading messages. The gateway stations are usually also packet radio BBS stations, and messages are forwarded by packet between gateways and end-users. UoSAT DCE gateways operate in New Zealand (ZL1AOX), Australia (VK5AGR), The United Kingdom (GB2UP), South Africa (ZS6SAT), and Germany (DB2OS). Project OSCAR is constructing a USA gateway.

In addition, isolated stations in Antarctica (ZL5BA) and Pakistan (AP2SUP, AP2PUL) communicate with amateurs worldwide using the DCE. UA3CR in Moscow has also used the DCE. The gateway system is an unusual way to access OSCAR satellites. It allows stations without satellite equipment to use the DCE, and the DCE gateway operators manage the limited memory available in the DCE.

On the other hand, part of the fun of OSCAR operation is directly accessing the satellites. New packet radio satellites UoSAT-D, the AMSAT-NA Microsats, and Fuji-OSCAR-12 are designed for open access to all amateurs, not just gateways.

Connecting Your Computer to UoSAT

If listening to the DIGITALKER and the HF beacons has excited your imagination, you'll want to decode some of the digital data from the UoSAT downlinks. Both satellites continuously transmit experimental data, and telemetry and news bulletins on their 145.825 MHz downlinks at 1200 bits/second. On board computer programs schedule experiments and determine what data to transmit, so the content of the downlink will vary as the satellite passes your station.

To decode the data, you need a computer (or a simple ASCII terminal) and a demodulator. Although demodulators specifically designed for UoSAT provide the best results, you can also try a telephone or packet radio modem which uses the Bell-202 tones. (The Bell-202 demodulator will receive UoSAT-1 correctly, but output data will have to be inverted to receive UoSAT-2.) When you graduate to receiving data from UoSAT, you must make sure that your receive signal is fairly strong. Although weak signals from a handheld are OK for the DIGITALKER, high-speed data communications requires better links.

A UoSAT demodulator is available from *AMSAT-UK, 94 Herongate Rd, London, E12 5EQ, United Kingdom.* Please send an envelope with IRCs for a complete price list of all AMSAT-UK satellite goodies. UoSAT data decoding software for the Commodore-64 computer is sold by Project OSCAR. Send an SASE to *Project OSCAR, Box 1136, Los Altos CA 94023-1136.*

Most of the data transmitted by UoSAT is 1200 bits/second ASCII, with even parity bits. Telemetry frames describe the state of all spacecraft systems and experiments every five seconds.

The on-board computer status messages and the news bulletins are in plain ASCII text. You can read them on screen or send them to a printer. To understand the telemetry and the WOD, you need to decode the data either by hand or with computer programs. The UoSAT Data Booklet, available from AMSAT-NA and AMSAT-UK, contains complete information on data decoding.

If you are naturally curious, you'll want to decode UoSAT data just for the fun of it, to find out what the strange signals mean. Once you have "cracked the code," you can try many interesting experiments. By plotting the output of the on-board magnetometer, you can determine how fast UoSAT is spinning in the Earth's magnetic field. By watching the battery voltage and the satellite's temperature, you should be able to see exactly when the satellite passes into or out of the Earth's shadow. Whole orbit data surveys of the Geiger counter on UoSAT-OSCAR-9 clearly show the enhanced radiation which causes auroral displays at high latitudes. Continuously transmitting 1200 bits of data per second, the UoSATs generate a wealth of information. It's up to you to use it!

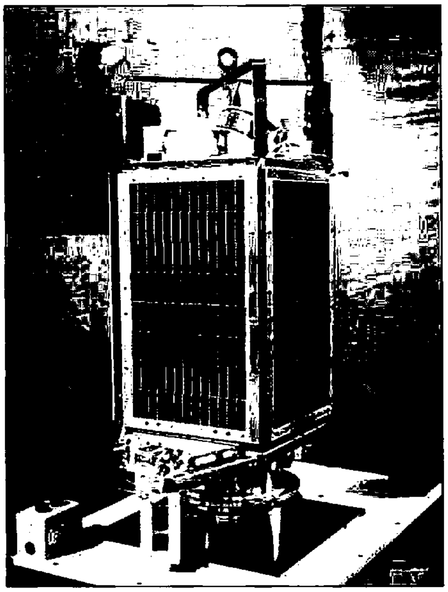


Photo D. UoSAT-OSCAR-11, completed and ready to integrate with the launcher. The bracket on top will be removed before launch. Note the 1.2 GHz antenna in the foreground. Photo by Martin Sweeting G3YJO.

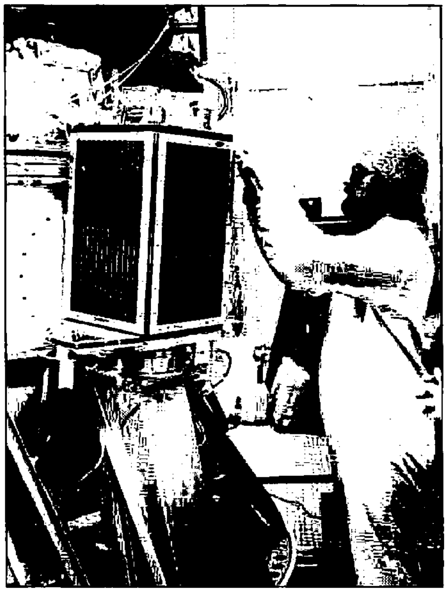


Photo E. Inside the launcher gantry at Vandenberg AFB, California. Ian Ferebee G6BTU places the solar panel on UoSAT-OSCAR-11. The satellite is in its final position, just below the main payload. Photo by Martin Sweeting G3YJO.

The New UoSATS

Technology has advanced since the launch of UoSAT-OSCAR-11; faster, smaller, lower-power computers are available to support more complex on-board experiments. A new group of radio amateurs and student engineers at the University of Surrey is ready to test its ideas in orbit.

Two new UoSAT-OSCAR satellites, designated UoSAT-D and UoSAT-E until launch, are under construction at UoS. (What happened to UoSAT-C? The UoSAT-C mission is an ongoing project, which will now be launched after UoSAT-D and UoSAT-E.)

Harold Price NK6K and Skip Hansen WB6YMH are working on a multi-tasking computer operating system. Larry Kayser has the Canadian battery testing team in action. The UoSAT team in England is constructing the bus and the payloads.

UoSAT-D and -E will be launched by the European launch agency Arianespace, on an Ariane-4 launcher, into 800-km, sun-synchronous, polar orbits. The primary payload is the French imaging payload SPOT-2, and there are six OSCAR satellites riding piggyback. Besides the two UoSATs, there will be four very small OSCARs called Microsats built by AMSAT-NA and described elsewhere in this issue. This is the first multi-satellite OSCAR launch for western AMSAT organizations, and it will be the first test of the new Ariane Structure for Auxiliary Payloads (ASAP).

Arianespace hopes to use the ASAP on Ariane to provide a continuing supply of low-cost launch opportunities for small educational and experimental satellites. The aerospace industry is learning from radio amateurs that small satellites are useful and cost-effective.

UoSAT-D PACSAT Communications Experiment

UoSAT-D is the first UoSAT satellite with communications as its primary mission. The UoSAT-D PACSAT Communications Experiment (PCE) will be an open-access, Mode-J, store-and-forward PACSAT transponder available to all correctly equipped ground stations. For engineers at Surrey, the PCE continues the communications experiments which started with the UoSAT-OSCAR-11 DCE. Once again, AMSAT is joining the Third World development organization VITA to test low-cost hardware and software appropriate for rural communications. VITA is funding the development of the PCE circuits, while AMSAT-UK is paying for the actual flight hardware.

VITA may have their own link to the transponder on a special FCC-licensed channel. (Rest assured that they won't be using amateur frequencies to access the PCE.)

The UoSAT-D PCE will be an advanced PACSAT transponder, using 9600 bits/s Frequency Shift Keyed (FSK) uplink and downlink. These links are compatible with special modems, such as the G3RUH FSK modem (available from AMSAT-UK), but it will not work with the modems built into existing TNCs.

The access protocols for the PCE will be specially designed for efficient use of the high speed link and the limited periods of satellite visibility. Using standard AX.25 packet radio as a starting point, new methods of chan-

Continued on page 102

73 Review

by Cornell Drentea WB3JZO

The Ampire 146-OS Low Noise Preamp

Ampire Inc.
10240 Nathan Lane
Maple Grove MN 55369
Price Class: Models 146, 146-OS: $180
Model 440: $190

A low-noise narrow band VHF/UHF preamp with *good IMD prevention.*

The science of low noise amplifiers has been a misunderstood one for many years, and for good reasons. To most of us, amplifiers seem simple to design and implement. There has been an abundance of available products on the market since the beginning of the tube, and since bipolar days. With the advent of the GaAsFET technology, the trend has been toward even lower noise figures at ever higher frequencies. Many Japanese (and fewer American) companies have, over the years, inundated this market with various products. While this trend continues today at VHF, UHF, and microwave frequencies, few companies have concentrated on providing preamplifiers expressly designed to reject potential out-of-band signals which can cause intermodulation distortion (IMD).

One such exception is an American company, Ampire Inc., with its new line of GaAsFET preamplifier products designed to be installed right at the antenna for an improved noise figure for any remotely located VHF/UHF transceiver operating in the 144–148 MHz and 440 MHz bands. The Ampire preamplifiers' unique narrowband design provides a low noise figure with improved immunity to strong adjacent signals. Their main feature is their ability to reject out-of-band signals before they get into follow-up receivers and result in image-related or other intermodulation distortion products. They do this with the help of a very linear GaAsFET amplifier stage, followed by a narrowband passive helical filter.

These preamps automatically switch from receive to transmit by sensing the RF energy going into the antenna for the duration of a transmission. Although no gain is realized in transmit, approximately 160 Watts of RF can be switched and passed reliably through the device.

I recently had a chance to evaluate the Ampire 146-OS, a product which is intended for channelized 2 meter communications, and particularly for OSCAR operation.

Electrical Specs and Performance Tests

The 146-OS is the factory adjustable, narrowband version of the Ampire line. In other words, the company will tune the product to your specified frequency for no additional cost. The sample unit came adjusted for OSCAR operation at 145.8 MHz.

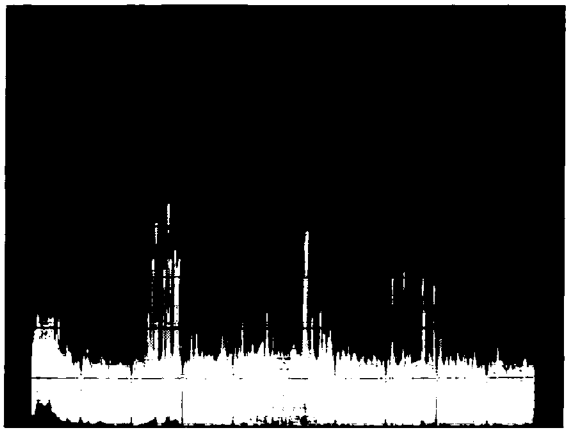


Photo A. Spectrum analyzer results show how many intermodulation distortion-causing signals are present at the antenna.

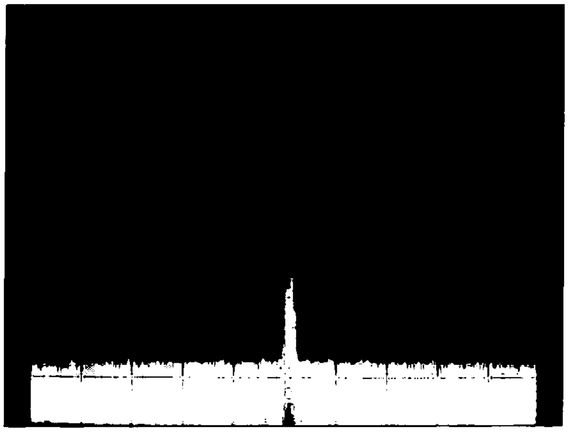


Photo B. Distortion is reduced substantially when the Ampire 146-OS product is switched in. Only the desired signal is passed by the unit with improved signal-to-noise ratio (NF=0.75 dB) and 20 dB of gain.

Laboratory measurements showed a 1.4 MHz bandwidth at the 3 dB points (all other models exhibit a wider bandwidth). At this frequency, out-of-the-2-meter band signals were rejected by at least 15 dB and 20 dB respectively at the edges of the band. Further out, the rejection improved progressively to about −55 dB or better. (See Figure 1.) We measured the in-band noise figure at 0.75 dB, with a gain of 20 dB.

We performed a spectrum analyzer test of the Minneapolis area "EMI" scenario from 46 MHz to 246 MHz, first with the amplifier off, and then with the amplifier switched in, showing definite rejection of possible intermodulation-causing signals over the spectrum of interest. (See Photos A and B.)

The preamp performed unconditionally. We didn't observe any signs of oscillation during a twenty-four hour test involving switching between 100 Watts of transmitted RF power into a dummy load, and receive. The power handling specification of the 146-OS unit exceeds the specifications of most other similar products on the market today, which are usually rated at about 30 Watts.

In addition, the Ampire 146-OS product can switch up to 160 Watts of RF into a 50Ω load. The minimum RF power required to activate the automatic T/R switching detector was 150 milliwatts, quite adequate for many of the low power settings on today's handhelds.

The automatic R-to-T transition of the unit happened at 10 milliseconds (a function of the RF relay mechanics), and the T-to-R transition was at 0.750 seconds. This is the standard delay provided by Ampire and it's intended for SSB operation. You can order other timing options at no additional cost.

We also performed a temperature chamber test, with good results. The

continued on page 102

Number 19 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

LOUISVILLE KY
MAY 1-6

Special Event Station KB4DCG will operate on the above dates to celebrate the 115th running of the Kentucky Derby. Suggested frequencies: 7.237, 21.337, and 28.437. For certificate, send OSL and two units postage to *KB4DCG, 641 Camp St., Louisville KY 40203.*

S. SIOUX CITY NB
MAY 5-6

The 3900 Club, in conjunction with the Sooland ARA, is sponsoring its Hamboree #11. Seminars include beginning and advanced packet, QRP, satellite, ARRL Forum, FCC, QCWA luncheon, MARS, and more. Reserve flea market tables through *WØPEX, Al Smith, 3529 Doughlas Street, Sioux City, IA 51104.* For reservations and information, contact *WØFZO, Dick Pitner, 2931 Pierce Street, Sioux City IA 51104.*

SIERRA VISTA AZ
MAY 5-7

The Cochise Amateur Radio Association (CARA) will hold its Annual Hamfest at the club training facility five miles east of town and 2 miles south on Moson Road. No charge for tailgaters. VE exans, overnight RV camping (no hookups). Talk-in on 146.52 or 146.76 (−0.6). Handicap facilities. Contact *N7INK, (602) 378-3155 after 6 PM* or write *CARA, PO Box 1855, Sierra Vista AZ 85636.*

BIRMINGHAM AL
MAY 5-7

The BirmingHamfest '89 will be at the Birmingham-Jefferson Civic Center on the main floor of the Exhibition Hall. Admission $5 per adult, booth reservation entitles you and employees for free admission. Flea market, forums, testing, awards, non-ham activities. *Exhibitor Chairman: Dan Morgan KB4MDI, (205) 622-5242. BirmingHamfest '89, PO Box 26073, Birmingham AL 35226.*

CEOARBURG WI
MAY 6

The Ozaukee Radio Club presents its Eleventh Annual Swapfest at the Circle B Recreation Center. Admission, $3 at the door, $2 in advance. Tables, $3. Hourly prize drawings. Talk-in on 146.37/.97 and 146.52. To pre-register, send postcard with callsign and license exam desired to *Badger Examiners, ℅Gary Sharbuno WA9UJK, 5119 W. Willow Road, Brown Deer WI 53223. (414) 466-5379.* For more information and reservations, contact *Joe Bauer W9WO at (414) 692-2329* or write *O.R.C. Swapfest Committee, N5415 Crystal Springs Ct., Fredonia WI 53021.*

BEMIDJI MN
MAY 6

The Paul Bunyan Radio Club will hold its annual hamfest on Saturday at the new V.F.W. Club. Talk-in on 146.13/.73. Dealers, exams, and flea market. Write *Robert W. Bitz KAØKTB, 401 Roosevelt Manor, Bemidji MN 56601. (218) 751-8748.*

BREWSTER NY
MAY 6

The Putnam Emergency Amateur and Radio League will have their PEARLfest at the John F. Kennedy Elementary School. It will feature ham gear and VE exams. Admission, $3, tables, $8; tailgating, $5. Talk-in on 145.135 down 600-KG1O/Repeat. For registration, contact *Terri Cullum N2GWF, 40 Mile Hill Road, Highland NY 12528* or *Jim Morgan KA2FIQ, 39 Overlook Road, Ossining NY 10562.*

GREENVILLE SC
MAY 6-7

The Blue Ridge Amateur Radio Society is sponsoring the 50th Annual Greenville Hamfest and Electronic Flea Market at the American Legion Fairgrounds. It features walk-in exams, indoor dealer displays, indoor/outdoor electronic and computer flea market, free parking, camping, and prizes. Admission, $4 in advance; $5 at gate. For information or tickets, send SASE to *Blue Ridge Amateur Radio Society, PO Box 6751, Greenville SC 29606.*

SANDWICH IL
MAY 7

The Kishwaukee Amateur Radio Club is sponsoring their 34th annual hamfest at the Sandwich Fairgrounds. Overnight camping, no hookups. Reserved tables, $5 in advance. Tickets, $3 in advance, $4 at the door. Talk-in on 1373. Contact *Howard Newquist, PO Box 264, Sycamore IL 60178.*

PARAMUS NJ
MAY 7

The Bergen Amateur Radio Association (B.A.R.A.) will sponsor its annual spring hamfest at the Community College. Buyers, free admission; sellers, $5 per space. Amateur testing, walk-in only. Novice through Extra. Free parking. Talk-in on 146.19/.79. Contact *Jim Joyce K2ZO, 286 Ridgewood Blvd., No. Westwood, NJ 07675. (201) 664-6725.* For testing information, contact *Pete Adely K2MHP, 13-30 Edward St., Fairlawn NJ 07410. (201) 796-6622.*

PROMONTORY UT
MAY 10

The Odgen Amateur Radio Club will operate W7STB from Promontory Summit to commemorate the 120th year of the driving of the Golden Spike. Time: from 0001Z to 2100Z. Frequency, one of: 3.970, 7.270, 14.280, 21.375, or 28.415 MHz. Send OSL and SASE to *Ogden Amateur Radio Club, PO Box 3353, Ogden UT 84409.*

FAIRFIELD CT
MAY 13

The Greater Fairfield ARA, Inc., will operate a special event station during the 54th annual Dogwood Festival from 1300Z-2200Z. Suggested frequencies: 3.975, 7.235, 14.330, 21.420, and 28.310 MHz. For a 9x11-inch certificate, send QSL and large SASE to *FARA Dogwood, PO Box 486, Southport CT 06490-0486.*

BELLEVUE WA
MAY 13

Crooked Stick and Rats Nest OSO Party, sponsored by the Issaquah ARC, encourages new Novices, the handicapped, and all other hams, to participate. Bonus points for photos and information about your contest operation. For details, write *Martha Stedman N7IVX, 15423 SE 7th Pl., Bellevue WA 98007.*

PIERRE SD
MAY 13-14

The Pierre ARC will operate WØHVY from 1100Z to 2300Z the 13th and from 1500Z to 2300Z the 14th to commemorate 100 years of statehood. Suggested frequencies are: 28.400, 21.287, and 14.287 kHz USB; and 7.267 kHz LSB. For certificate, send QSL and 9x12 SASE to *Gary Wallace KAØAHI, POB 1261, Pierre SD. 57501-1261.* Deadline June 10, 1989.

LAS VEGAS NV
MAY 13-14

1989 Nevada QSO Party, sponsored by the Frontier Amateur Radio Society, an ARRL Special Service Club. From 0000Z the 13th to 0600Z the 14th. 6-160 meters. CW/SSB/FM/RTTY/PACKET/SSTV. No cross-mode or repeater OSOs. Suggested frequencies: CW 15 up from bottom of general bands; phone −25 up from bottom; Novice and Tech portion of bands.

Exchange: Nevada-RS(T) and county, others-RS(T) and state/province/DXCC country. One point for each contact per mode. Multiply points by number of NV counties worked. Certificates to top scores in each category. Mail logs by June 1 to *Jim Frye NW7O, 4120 Oakhill Ave., Las Vegas NV 89121.*

ATHENS OH
MAY 14

The Athens County Amateur Radio Association (ACARA) will hold its 10th annual hamfest at the City Recreation Center. Large flea market, door prizes. Tailgaters. Talk-in on the club repeater at 145.15/.55 MHz. Indoor space available only by pre-registration. Contact *Rod Holley KA8NDC, 15267 S. Canaan Rd., Athens OH 45701. (614) 593-8177.* To register for license exams, mail completed FCC Form 610 and $4.75 payable to ARRL/VEC to *John Cornwell NC8V, 101 Coventry Lane, Athens OH 45701.* Walk-ins accepted. For general information, contact *Carl J. Denbow KA8JXG, 63 Morris Ave., Athens OH 45701.*

CADILLAC MI
MAY 20

The annual Swap and Shop of the Wexaukee ARA will be at the Cadillac Middle School. Admission, $3; tables, $6. Talk-in on 146.37/.97 repeater. Contact *John Craddock KX8Z, (616) 797-5491* or write *Wexaukee ARA, PO Box 163, Cadillac MI 49601.*

KNOXVILLE TN
MAY 20

The Radio Amateur Club of Knoxville presents the 1989 ARRL Tennessee State Convention and the 23rd Annual Knoxville Hamfest and Computer Fair at the Kerbela Shrine Temple. ARRL forums, Joe Fairclough WB2JKJ on using ham radio to teach, packet demonstration, DXpeditions, VEC exams, prizes, and flea market. For reservations, contact *Joe Meighan KB4REC, Rt. 26, Central Avenue Pike, Knoxville TN 37919. (615) 558-8487.* For exam registration, contact *Ray Adams N4BAQ, WCARS/VEC, 4325 Felty Drive, Knoxville TN 37918. (615) 687-5410.*

ABILENE TX
MAY 20

The Key City ARC will hold its Fourth Annual Armed Forces Day Ham Fest at the Civic Center. Pre-registration, by May 18, is $5; at door, $8. Tables, $2 each. VE exams, walk-ins OK. Large arts/craft show same building. *Bill Jones N5DOX, (915) 698-4606/7290 days, 3935 nights; or WB5EKW-3 Gateway 7096/145.01 or AE5I Autoforward BBS via DBL, BRD, WIN, or ALB.*

SEVERNA PARK MD
MAY 20

The Maryland Mobileers ARC will operate WA3PJQ aboard the submarine *USS Torsk* (SS-423) from 1400Z to 2100Z to honor the submarine service. Frequencies, ± QRM will be: SSB-7240, 14240, 21340, 28340 kHz, and FM 146.805 (repeater output). For certificate, send a legal-size SASE to *MMARC, PO Box 784, Severna Park MD 21146.*

GODFREY IL
MAY 20

The 3rd Annual Lewis & Clark Radio Club Hamfest and Electronic Flea Market will be at the Lewis & Clark Community College. Prizes, display (packet, satellite, ATV, WEFAX, AMTOR), commercial vendors, ARRL booth, giant flea market with no charge for space, exams, and free parking. Advance, 7 for $5; $1 each at door. Talk-in on Club 2 meter net (Monday at 8 PM) on 145.23 repeater. *Lewis & Clark Radio Club, PO Box 553, Godfrey IL 62035. (618) 466-1909.*

SPRINGDALE AK
MAY 20

The Northwest Arkansas ARC will hold its Ozark Hamboree at the Rodeo Community Center. Plenty of parking. Flea tables, $5. Retailers will show all new ham gear. Door prizes, programs, VE exams on a walk-in basis. No charge for attendance. Contact *Randall Spear WA5QGH at (501) 846-3210.*

DULUTH MN
MAY 20

The Arrowhead ARC presents SWAPFEST '89, held at the First United Methodist Church. Hourly drawings, main door prize. Admission, $4, 4-foot tables, $5. Talk-in on 146.34/.94 MHz. Contact *Duane Flynn KB/OLC, 4907 Peabody St., Duluth MN 55801. (218) 525-4580.* Pre-register for exams with *John Crow KAØSYN, 1365 Roland Road, Cloquet MN 55720. (218) 879-5356.*

COLORADO SPRINGS CO
MAY 20

The Pikes Peak Radio Amateur Association will hold its Swapfest at the Rustic Hills Mall. Admission free. Tables, $8 in advance, $10 at door. Talk-in on 146.37/.97. Contact *Al NØCMW, (719) 473-1660* or write *PPRAA Swapfest, PO Box 16521, Colorado Springs CO 80935.*

MILLINGTON TN
MAY 20

In recognition of the 40th Annual Armed Forces Day Celebration, Amateur Radio Station W4ODR will operate from 1300Z to 2300Z. SSB 7.230, 14.280, and 21.3780 MHz (± 10 kHz). CW on 21.145 and 28.145 MHz. 2 meters on 146.52 simplex. For details, contact *Lieutenant Robert D. Alley WA4WFJ (901) 873-5306; AX2 David A. Holding KB5BXJ (901) 873-5134; Sergeant Major Jim Moffatt WD4SMW (901) 363-0778; and Military Club Station W4ODR/Navy-Marine Corps, MARS Station NNNØNIF, Bldg. N-100, NAS Memphis TN (901) 873-5134.*

OAK PARK MI
MAY 20-21

The 1989 Michigan OSO Party will be sponsored by the Oak Park Amateur Radio Club. Phone and CW are combined into one contest. Michigan stations can work Michigan counties for multipliers. A station may be contacted once on each band/mode. Portable/mobiles may be counted as new contacts each time the county changes. For exchange, scoring, awards, and log requirements, write *Mark Shaw K8ED, 27600 Franklin Rd., Apt. 516, Southfield MI 48034.*

ROCHESTER NY
MAY 20-21

The Rochester Hamfest and Computer Show, in conjunction with the New York State ARRL Convention, will be at the Monroe County Fairgrounds. Dealers, exhibitors, booths, tables, contests, prizes, and noncommercial flea market. For more information, contact *Rochester Amateur Radio Association, Rochester Hamfest, 300 White Spruce Blvd., Rochester NY 14623. (716) 424-7184.*

ANDERSON SC
MAY 20–21

The Lake Hartwell 10th annual Hamfest is sponsored by Toccoa, Hartwell, Georgia; and Anderson, South Carolina; ARCs at the Hartwell Group Camp south of Anderson. Talk-in on 146.295 + 600, 146.19/.79, 147.93/.33. Free flea market space. For tickets and information, write or call *M.A. Counsell W1BNS, 215 Nottingham Way, Anderson SC 29621. (803) 261-7018.*

YAKIMA WA
MAY 20-21

The Yakima Amateur Radio Club W7AQ announces its Hamfest '89, which will be held at the State Fairgrounds in Yakima. VE exams, commercial exhibits, swap and shop tables, and lectures. Admission, $5; tables, $5. Talk-in on 146.66/.06, 146.84/.24. Contact *Dick Umberger N7HHU, (509) 453–8632, days; (509) 453–3580, evenings* or write *Yakima ARC W7AQ, PO Box 9211, Yakima WA 98909.*

ST CHARLES MO
MAY 20–21

The St. Charles ARC will operate WBØHSI from 1400Z to 2200Z as part of the Lewis and Clark Rendezvous. This special event station will transmit near 7250, 14325, 21350, 28410, and 146.67 as propagation and QRM permit. For certificates, send a large SASE to *St. Charles ARC, PO Box 1429, St. Charles MO 63302-1429.*

FOLSOM CA
MAY 21

The North Hills Radio Club is sponsoring its HAMSWAP at the Folsom Community Clubhouse. Free admission. Auction, tables ($6 each), tailgating, free parking, park with rides for kids. Talk-in on 145.19 and 224.78. Contact *NHRC, PO Box 41635, Sacramento CA 95841* or call *Bob WA6ULL at (916) 983–2776.*

CHICAGO IL
MAY 21

The Chicago Amateur Radio Club will hold its annual Mini-Hamfest at the North Park Village. Indoor area. Admission, $2. Contact *CARC, 5631 W. Irving Park Road, Chicago IL 60634. (312) 545–3622.*

WABASH IN
MAY 21

The 21st Annual WCARC Hamfest will be held at the Wabash County 4-H Fairgrounds. Admission, $3.50 in advance, $4 at door. Inside tables, $10. Prizes, large outdoor flea market, free parking and overnight camping, and examinations for Tech to Extra. Talk-in on 147.63/.03, 146.52/.52, and 146.94/.94. For ticket information, send SASE to *Don Spangler W9HNO, 235 Southwood Dr., Wabash IN 46992. (219) 563–5564.*

KNOXVILLE IL
MAY 21

The Knox County Radio Club, Inc., will hold its annual Knox County Hamfest at the County Fairgrounds. Large commercial display building and acres of outside flea market space at no charge. The Knox County Pork Producers will be serving their Butterfly pork chops. VE testing nearby. Talk-in on 147.00/146.40. For table reservations, pre-registration of testing, and advance tickets, write *Keith L. Watson WB9KHL, 119 South Cherry Street #3, Galesburg IL 61401-4527* or call *(309) 342–3885 evenings.*

AOENA OH
MAY 21

The Triple States Radio Amateur Club will hold its 11th annual Wheeling Hamfest/Computer Fair at Wheeling Park. Roofed area for dealers, six acres of flea market. Children 14 and under free. Admission, $4 in advance, $4 at door. Contact *TSRAC, Box 240, RD 1, Adena OH 43901. (614) 546-3930.*

WRIGHTSTOWN PA
MAY 21

The Warminster ARC is sponsoring their 15th annual Hamfest at the Middletown Grange Fairgrounds. Admission, $4 (XYLs and children free). 80 indoor spaces with 8-ft. tables, $5 space. New equipment vendors, large flea market, amusements for children. Talk-in on 146.52 simplex and 147.09/.69, 223.76/222.16, 52.04/53.04 repeaters. For information or pre-registration, contact *Bill Cusick W3GJC, Apt. 804 Garner House, Hatboro PA 19040. (215) 441–8048.*

DALTON MA
MAY 21 (& AUG 13)

Ham Radio Flea Markets, sponsored by the Northern Berkshire ARC, will be at the Dalton American Legion. Talk-in on 146.91. Admission, $1. Free tailgating space. Contact *Dick WB1HIH at (413) 458-8267/8452.*

NAMAO ALBERTA
MAY 26–28

The Northern Alberta Radio Club is sponsoring a Ham Fest and Flea Market on the above days. Dealers, demonstrations (SSTV, packet, SWL, RTTY, satellite, computers, radio museum), awards. Students 18 and under, free. Adults, $5 at door, $4 pre-registered. Banquet, breakfast, RV parking. No hookups. Send SASE to register to *Northern Alberta Radio Club, 9628–69A St., Edmonton, Alta CANADA T6W 1W3. (403) 438–9205.*

PETAL MS
MAY 26–JULY 18

The Amateurs of Petal and Hattiesburg will be operating on the above dates to celebrate the International Checkers Tournament. Operation will be in the lower general portions of all bands and the Novice SSB portion of 10. Send QSL and large SASE to *KA5UBL, PO Box 2131, Hattiesburg MS 39403-2131.*

DURHAM NC
MAY 27

The Durham FM Association will hold its 10th annual "DURHAMFEST 1989" at the South Square Mall. Vendors and plenty of free tailgating space, table rental, and AC power for testing equipment. FCC exams by pre-registration. Contact *Pete Goolsby KY4Y, 120 Radcliff Circle, Durham NC 27713.* Talk-in on 147.825/.225, the Friendly Repeater WA4WTX/R. *Mick Rankin W4ZUS, 1001 Wedgewood Lane, Durham NC 27712.*

HAMILTON SCOTLAND
MAY 27–28

The Scottish Tourist Board (Amateur Radio) Expedition Group operates a special events station at various times of the year. In May GB2RB the focus will be Robert Burns, Scotland's famous poet, at the Burns House Museum, Mauchline, Ayrshire. The group issues two certificates, both in color. For details, write the above group at *PO Box 59, HAMILTON, SCOTLAND ML36QB.*

NASHVILLE TN
MAY 27–29

The Nashville Amateur Radio Club K4CPO will operate, during daylight hours only, in various sections of the phone band, a special events station aboard the General Jackson stern-wheeler as she cruises the Cumberland River on Memorial Day weekend. Full-color QSL card of the General Jackson for your card and SASE to *K4CPO Nashville ARC; see call book.*

WEST FRIENDSHIP MD
MAY 28

The Maryland FM Association, Inc., presents its annual Memorial Day Hamfest at the Howard County Fairgrounds with commercial displays and ample parking. Admission, $4. Tailgating, $3. Table rental, $7 in advance and $10 at the Hamfest, if available. For license exam reservations, contact *Steve Silberman K3RMX, (301) 578–8527.* Talk-in on WA3DZD/Repeater (146.16/.76, 222.16/223.76, and 449.1/444.1). Contact *Mike Cresap, 1294 Dorothy Road, Crownsville MD 21032. (301) 923–3829.*

BUCKHANNON WV
MAY 28

The Buckhannon ARC and the West Virginia Wesleyan College ARC will operate W8WVM from 1400Z to 2200Z to celebrate the 48th Annual West Virginia Strawberry Festival. Suggested frequencies: 7.250, 14.250, 18.150, 28.350. For a special QSL, send your QSL and SASE to *West Virginia Strawberry Special Event, PO Box 65, Buckhannon, West Virginia 26201-0065.*

COLLEGE PARK MD
PRIOR MAY 31

The Foundation for Amateur Radio, Inc., a non-profit organization headquartered in Washington DC, plans to award 32 scholarships during 1989–90. If you plan a full-time course of university studies and are enrolled in or have been accepted in a university, college, or technical school, request more information at *FAR Scholarships, 6903 Rhode Island Avenue, College Park MD 20740.*

1269 MHz Helix Array

Wind your way to higher gain.

by Ralph E. Herzler WA8WBP

Soon after finally taking the big step—assembling a successful Mode L system of no less than 35 Watts to a 12-turn helix antenna for an uplink—I began to think about upgrading it. Increased RF power was not an attractive option because I was heterodyning a 2 meter signal to 23 cm at the antenna, and amplifying to the limit of available solid state equipment. However, my first helix offered such an attractive gain (16 dBi) for such a small space that the helix idea seemed logical.

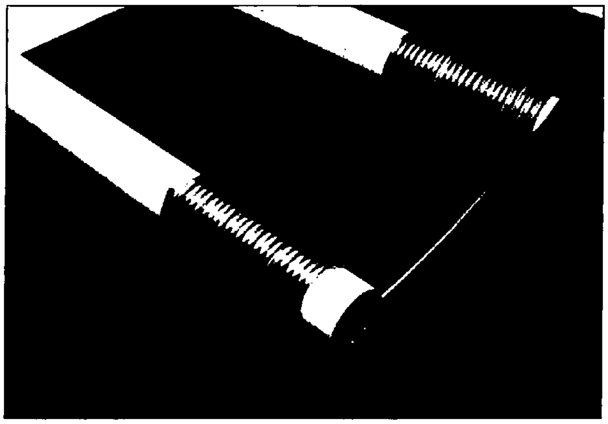


Photo A. A 50-foot coil of ¼" copper refrigeration tubing, wound 46 turns over a piece of 2" PVC pipe, is the beginning of the helix array. It's important to wind the helix as a right-hand thread.

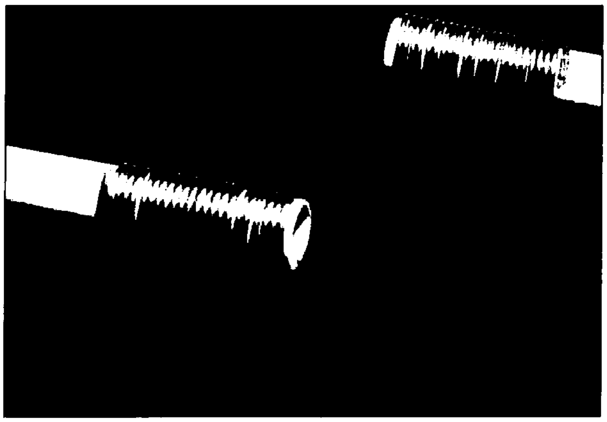


Photo B. After finding the mid-point of the helix, unwind enough tubing from each side to space the closest helix turns 24 cm apart. Then twist the two coils 180 degrees to form two parallel helices.

Searching for a Worthwhile Gain

From my research of the RSGB *VHF/UHF Manual*, I found that one way to upgrade was to lengthen the helix to 20 turns, for an increase of 17 dBi. My 35 Watts equates to 15.4 dBw, so I could expect this combination to result in a 32.4 dBw EIRP (1.7 kW). Not enough! The opportunity to gain another 3 dB is very tempting. Furthermore, I have heard from a number of hams, including John Hogan KC7GY, who have done this successfully. If I could make this work, I might achieve an antenna gain of 20 dBi! That could net 35.4 dBw EIRP (3.47 kW), a worthwhile gain!

Unfortunately, my one contact with KC7GY took place when his multiple helices were covered with ice and snow, late in the Mode L segment of the orbit. However, I did learn that he was using conventional helices with a commercial power divider. What I didn't learn was the spacing used to stack the antennas. Shortly thereafter, when I might have been able to get back with John, Mode L was coming to life in the early hours here in Michigan, and even earlier in White Salmon, Washington. In my anxiety to develop a more effective system, I took off on my own theory.

Since power dividers introduce some amount of loss, I designed an array of two 20-turn helix antennas on a common back plate to use without a power divider. I figured that if a single helix had a characteristic impedance of 140Ω, then two helices in parallel would have a combined impedance of 70Ω.

I further planned to space the helices one wavelength apart, hopefully to feed them in phase. I would use the same material that formed the antennas, crossing diagonally over the reflector and tapped at the midpoint for coaxial feed. My reasoning was to keep the cross-over reasonably close (about ½") to the reflector so that I could add capacitive plates to improve the impedance match, if necessary.

New Use for Refrigerator Tubing

I bought a 50-foot coil of ¼" copper refrigeration tubing, and wound 46 turns over a piece of 2" PVC pipe (see Photo A). Two-inch pipe is actually 2.375" OD, so the final helix would have an outside diameter close to three inches. A small notch in one end of the plastic pipe, and a sharp bend in the tubing to fit the notch, make this job much easier. It is important to wind the helix as a right-hand thread.

Then I found the midpoint of the helix, and unwound enough tubing from each side of this point to space the closest helix turns 24 cm apart. The two coils can then be twisted

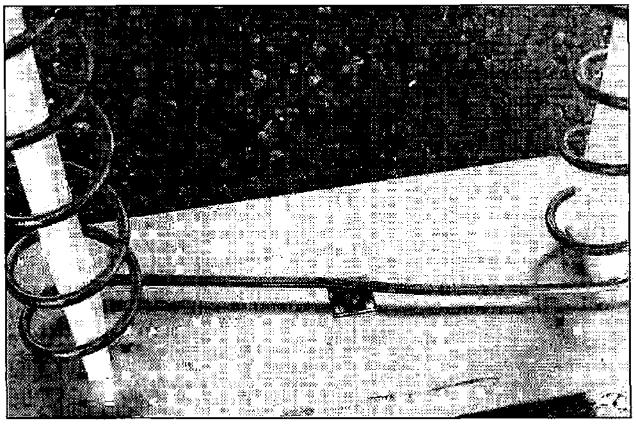


Photo C. *The crossover should nearly meet the chassis connector, and they should be carefully and securely soldered together at that point.*

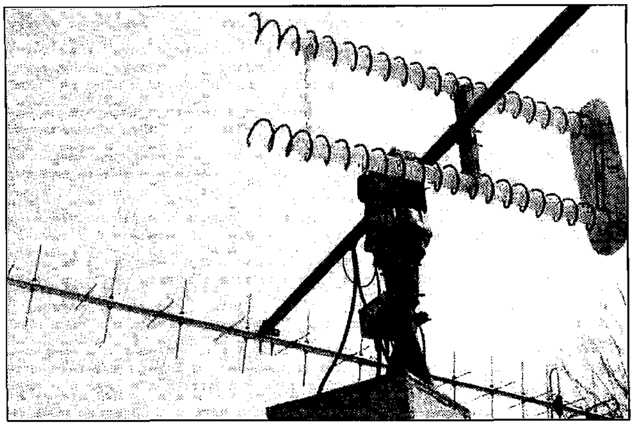


Photo E. *The finished 1269 MHz Helix Array, balanced and cross-braced.*

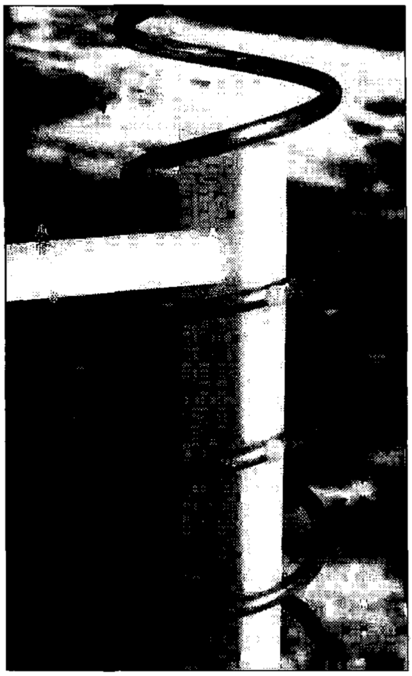


Photo D. Trim the coils to allow only 20 turns of helix to extend from the reflector. Note the ¼-20 nylon bolts.

180 degrees to form two parallel helices (see Photo B).

Prowling through my nearest Cadillac Plastics warehouse, I found a 6-foot long piece of polyethylene, ½" thick by 3¼" wide. Because of its awkward size, they gave it to me without cost. After sawing it into two 36" lengths for easy handling, I cut two 2¼"-wide strips to serve as supports for the coils.

I drilled one small end of each plastic support strip and tapped it for ¼-20 nylon bolts with which I would attach the reflector (see Photo C). Next I drilled one edge of each support and tapped for 6-32 nylon bolts which would secure the tubing at the proper 2" pitch. I found that with the first hole drilled ½" from the bottom of the support, holes every four inches secured every other turn of the helix quite adequately (see Photo D).

You must stretch the tightly-wound copper coils carefully to match the mounting holes, and drill them to clear the 6-32 bolts. I used steel bolts to establish the pitch, then replaced them later with nylon.

I made the reflector from a 19½" x 7" piece of 0.072" aluminum by rounding the ends on a 3½" radius. Since the antenna won't be mounted at the rear, the thickness of the reflector is not critical. Drill ¼" holes at the centers of the end radii to mount the polyethylene supports, and a ⅝" hole at the center of the reflector to mount a type N chassis connector (see Photo C). After mounting the connector, you can partially assemble the antenna.

". . . two helices in parallel would have a combined impedance of 70Ω."

A several-turn portion of each coil will protrude beyond the end of the plastic supports. You should trim this back (diagonal cutters work well) to allow only 20 turns of helix from the reflector (see Photo D). The crossover should nearly meet the chassis connector, and they should be carefully and securely soldered together at that point. I added a cross brace near the outboard end of the helices, using a piece of the polyethylene trim from the forming of the supports. After drilling and tapping the support, I used ¼-20 nylon bolts.

Because of the weight of this antenna, I decided to center-mount it for better rotational balance. For the support, I used a piece of 2¼" wide, 1" thick oak, fitted to the balance point of the assembly so that no part of the wood touched any point of the helix (see Photo E). I drilled each end of the oak support and fitted them with two brass adapters for ¼-20 bolts to wood. The coil supports were drilled to clear the nylon bolts used to join them to the oak cross member. Last, I drilled suitable holes in the wooden support to accommodate the normal U-bolt mount.

Does It Work?

I can't believe that I mounted and tested this contraption on a twenty-degree, snowy day in Michigan, but I did. The needle of a Bird wattmeter with a 25 Watt slug for this frequency pegged on forward power. I wasn't really too surprised because my PA had been tested with full 10 Watts 1269 input, and showed in excess of its 35 Watt rating. The reflected power measured only 3 Watts, for a calculated SWR of 1.8:1. Not bad for an unsophisticated design! Someday I may try for a better match, but I know it won't change the performance.

As if testing my design in winter weather weren't enough, I interrupted my night's sleep at 3:30 a.m. to catch a Mode L schedule. Egon DL9GZ gave me a good report. It wasn't a barn burner, but it showed significant improvement. Time will tell the rest of the story. I had the fun of building it for $29.07 (see the Table). 73

Material/Part	Source	Cost ($)
Copper Tube	Coast to Coast Hardware	17.95
Brass Inserts	Coast to Coast Hardware	1.60
1/4-20 Nylon Bolts	Coast to Coast Hardware	1.20
U-bolt	Coast to Coast Hardware	.79
Aluminum Sheet	NW Welding, Sturgis MI	4.68
6-32 Nylon Bolts	Hosfelt Electronic, Steubenville OH	1.60
N Chassis Connector	Hosfelt	1.25
	Total	$29.07

Space Education Network

Hams, spaceniks meet on A-O-13!

by K.O. Learner, II K9PVW and Greg Barr

Over the past few months, the AMSAT Space Education Network (SEN) has been bringing news, educational material, and tutorials on the activities of the world's space research organizations to satellite users within the OSCAR 13 footprint. For approximately 60 minutes each week, the scripts and voices of volunteers across the United States are beamed into space and retransmitted by a satellite built and prepared for launch by volunteers from around the world.

This unique activity shows how a common interest in space and communications is bringing together people of diverse backgrounds into a network of active contributors. Their goals are: to improve individual skills in the art of space communications; to link the amateur radio community and people interested in space science and technology; and to create a weekly network of amateur radio stations via an amateur radio communications satellite to discuss material of interest to the amateur space community.

Genesis of SEN

The creation of this network began over two years ago when AMSAT Vice President Dr. John Champa encouraged us to formalize and present the idea to the AMSAT General Meeting in November 1987. We picked topics for possible inclusion in each weekly bulletin. The most obvious of these is the transmission of news about world space programs from trade magazines and specialty publications. Following the news, we proposed that volunteers develop topics of interest, such as improvements in space transportation, the development of a joint US-Soviet space mission, NASA's plans for a Mars mission, and similar in-depth feature material. During the first half of the net session, we allowed time for retrospective features and thoughtful comments.

We followed the news and feature segments with one or more tutorials ranging over a broad area of technical and scientific issues. Examples of possible tutorials include a description of how the amateur radio communications satellite, being used for the SEN, operates; how it was launched into orbit: and how its operational characteristics were determined. We expected tutorials to range from orbital mechanics to astronomical observations.

The neatest aspect of the SEN through the hamsat is the possibility for interactive discussion, during which those who produced the material would be present to answer questions from the audience. This interactive participation would make it possible for the network to reach into the classroom through interested amateur radio operators who seek to interest young people in radio communications, as well as to excite them about participating in the development of space.

> ***"With over 1000 OSCAR stations in the US, with many of these capable of providing an input to a local repeater, the SEN could be available at nearly any location."***

With over 1000 OSCAR stations in the US, with many of these capable of providing an input to a local repeater, allowing reception over a large area with a handheld radio, the SEN could not only reach classrooms, but be available at nearly any location.

SEN's First Session

The Space Education Network became a reality with the launch of AMSAT's Phase IIIC spacecraft from the Kourou, French Guiana space facility by the first Ariane IV vehicle. The first session of the SEN was held on AMSAT-OSCAR-13 (A-O-13) during Labor Day weekend, September 3, 1988. The downlink frequencies were (and will continue to be) 145.960 MHz, Mode B and 435.900 MHz, Mode L.

Mars was the major topic of discussion, since it would pass particularly close to Earth later in the month, and it would be well-placed in the evening sky (for the northern hemisphere). Greg Barr reported on the Russian Phobos missions to Mars and to its moon, Phobos. These spacecraft promised to make the first close approach to Phobos and remotely analyze its composition for future investigations. Various astronomy publications provided information to aid observers in enjoying the magnificent view of Mars, whether visually, as a bright red spot in the sky, or through a telescope. Also in the first bulletin, Martin Pfefferkorn, Jr., reported on other items of space news from various journals.

The NASA Pathfinder Project

A typical feature is the ongoing series about the recently funded NASA Pathfinder Project. To coordinate and develop the technologies necessary to sustain humans in space, NASA has created a program that will use these technologies on missions. With the documentation available, it was easy to research the Pathfinder Project and rewrite the documentation summary to reduce technical jargon. An interview with Dr. John Mankins, the project manager, supplemented the material NASA provided.

We edited the material into segments of under 10 minutes each, to allow for station identification, then we used these segments as scripts for a live recording on a high quality cassette recorder and microphone. We used a filter to reduce frequencies below 500 Hz which decrease audio clarity in radio transmissions.

The NASA Pathfinder Project feature illustrates the AMSAT Space Education Network's ability to transmit up-to-the-minute information that would not normally be available through other media for many months, if at all. Even the trade magazines don't cover this topic in depth, since it isn't relevant to the commercial interests of their readers. The SEN Pathfinder series shows how information about the cutting edge of technology can be brought directly into the community. It is especially fitting that communities all across the country are accomplishing this task.

Plans for Future Sessions

In October 1988, the SEN added Retrospective segments written by William Wilson

Goodson, Jr., and narrated by Martin Pfefferkorn, Jr. Each Retrospective brings back a moment of history in the exploration of space. Many of these memories are exciting, joyous occasions of human triumph; but, as we all remember, some are not. William helps us to remember those who have already given so much to space exploration. Retrospective is a part of each session of the SEN.

The SEN has reported on the development and flight of two weather balloon ATV experiments by WB8ELK and W9PRD. More flights of this nature are planned, and information on how you can participate in these very interesting experiments will appear on the SEN.

Recently, William Black K4BSN, publisher and editor of *The Radio Meteor Review*, shared his publication of radio meteor research and data collection with the SEN. We are planning to have tutorial sessions on observing meteors via enhancement of signal strength over a radio path and topics in amateur radio astronomy.

Visual Augmentation

In future sessions, the SEN will be presenting information on diverse projects, such as solar sailing, amateur lunar orbit operations, future ham-in-space missions on the space shuttle and space station, and receiving pictures from weather satellites. Sometime in the future, you can request an amateur ground telescope to electronically photograph an interesting configuration of Jupiter's moons, or get a good view of a comet visible only in the opposite hemisphere!

Tutorial sessions can show a line drawing of the topic under discussion, such as a diagram of the A-O-13 orbit around the Earth. Photographs of a spacecraft or any of its systems can be shown to reinforce the description. Imagine the terrific views that will, in the very near future, come from the Hubble Space Telescope, or which one day may come from an amateur space telescope.

At present, we are using slow scan TV (SSTV) to show pictures during the SEN. SSTV is transmitted on 145.965 MHz. We have been experimenting with SSTV since November 1988, and we've received good quality, 8.5-second frames with signal strengths about equal to the A-O-13 beacon strength. SSTV reception reports have come from England and Japan, but as yet, very few have come from US stations.

With the advent of the digitized TV frames the WEBERSAT (MICROSAT-D) project will initiate, amateur radio will have a new, high quality, TV transmission standard. The WEBERSAT technique is to digitize the picture and transmit it by packet radio. AMSAT will provide the software for recreating the pictures in your station. Watch for this exciting development on the SEN.

Get in Touch!

Listen to the SEN on Saturdays on 145.960 MHz, Mode B and 435.900 MHz, Mode L. Join the fun by checking into the net and inviting friends who are interested in space activities to your station, or provide a gateway operation so that repeater users may join in. Remember, those friends might just become interested in amateur radio, too. The SEN wishes to thank these gentlemen who have served as NCS: Pete K1PXE, John K8OCL, and RIP WA2LQQ.

The AMSAT Space Education Network is a growing operation which needs your support. If you can help in any capacity, from writing, reading, serving as a net control station (NCS), to operating a repeater in your area, you will contribute to the growth of a substantial community educational service. Not everyone has the desire to read their own scripts or has adequate equipment for quality recordings. One of the network volunteer functions includes receiving and recording scripts from researchers and writers.

For further information, please contact the authors at the following addresses: *Greg Barr, 1412 Potomac Ave SE, Washington, DC 20003.* (Gregg Barr is the former Administrator of the L5 Society, and Deputy Executive Director of the National Space Society. Currently, he is the Director of Development at Action on Smoking and Health.)

K.O. Learner, II K9PVW, PO Box 5006, Kokomo IN 46904-5006 and by packet radio on KD9QB. (K.O. Learner is Senior Engineer, Systems Integration, Delco Electronics Corp., GM-Hughes Electronics, manager of the Learner Farms, and an AMSAT volunteer as AMSAT SEN project manager.) 73

Radio Links to Phase III-D

Satellite operation with a handheld in the near future?

by Dr. Karl Meinzer DJ4ZC
(translated by Don Moe DJ0HC/KE6MN)
and updated by Peter Guelzow DB2OS)

AMSAT-DL proposes that the next generation of Phase III satellites be termed Phase III D. For the radio amateur, the most important characteristic of these new satellites will be the significantly improved signal strengths. The relatively involved antenna installations as currently needed for OSCAR-10 and OSCAR-13 operation will then be unnecessary. In fact, the radio links can be improved to such an extent that mobile or even hand-held operation will be possible.

The P-III-D and Phase IV Project

The P-III-D design specifies an elliptical orbit so that worldwide activity is possible with just one satellite. In this case, the technology also remains fundamentally comprehensible, especially since the orientation control system in OSCAR-10/13 and the antenna geometry can be duplicated. The parameters for the elliptical orbit would be set more precisely, however, so that of the two daily eight-hour access intervals at our latitude, at least one interval would conceivably occur during local evening hours.

Recently, in the United States, the "Phase IV Project," a system of several geostationary satellites, has been under discussion. Since a continuous access of 24 hours daily has the highest priority there, they are willing to sacrifice the possibility of worldwide communications and to accept reductions in the achievable signal strengths. From the European point of view, it is more sensible to stay with satellites using the Phase-III orbit and gradually supplement them with geostationary satellites. In the long run, this results in a communications system which would permit worldwide contacts at any time.

A frequently mentioned advantage of the geostationary orbit is that antenna tracking is no longer necessary, and the operator can achieve relatively large antenna gains economically. In amateur practice this argument is only partially valid, since generally the antennas are also used for other types of operation, and rotors are required. The actual problem is that many amateurs are restricted from building large antennas, with or without rotors. P-III-D offers a solution from the other side: when the radio links are so good that even very small low-gain antennas are adequate, tracking is unnecessary. AMSAT-DL hopes that this philosophy will attract a larger number of people to satellite communications.

Later I will discuss why better signal strengths are possible in the P-III orbit than in a geostationary orbit, but now I will only mention that in a geostationary orbit, the main lobe of the antennas has to lie diagonal to the spin axis of the satellite. As a consequence, either a mechanically counter-rotating antenna, or a three-axis stabilized satellite, is required. In regards to our current launch opportunities, the bulkiness of the first solution reduces the gain by more than 8 to 10 dBi. The second solution involves such a complicated mounting and deployment mechanism for the solar generator that we dread to think of the development and risks.

The P-III satellites are relatively simple and well adapted to our launch opportunities; the main radiation lobe is along the direction of the spin axis, and we readily achieve antenna gains of up to 15 dBi. This argument could possibly change in the future, however, if the electrical power were increased over that planned for P-III-D. In this case, three-axis stabilized satellites are cheaper because the cost of the solar generator could be reduced by half.

The improvement of the radio characteristics of P-III-D compared to OSCAR-10 is achieved mainly through higher antenna gain at the satellite and higher transponder power. Both aspects presuppose a bigger satellite. The large number of users (100 simultaneous channels) requires a bandwidth that is only achievable on Mode-L. The nominal power generation was designed so that activity restrictions would only rarely be required. Current planning centers around a satellite with the specifications given in the Table.

Can You Reach the Bird?

In earlier satellites, the radio link to the satellite had virtually no influence on the achievable system performance. In the case of Mode L this is no longer correct, and under certain circumstances, this link can be more limiting than the satellite-Earth link. Is it therefore even possible to operate through P-III-D using simple stations? The path loss at 1269 MHz and 37,500 km distance amounts to 186 dBii. For the 300°K system noise temperature in the satellite, the noise power in the SSB bandwidth (2.4 kHz) corresponds to −170 dBW. To overcome the path loss with a 20 dB (PEP) noise margin, you need 36 dBW (PEP) minus antenna gains at both ends.

When an antenna gain of 15 dBi is assumed at the satellite end, the transmitter power on the ground must be 21 dBWi (PEP), or 126 Watts PEP into an isotropic antenna. It is in fact enough if, for example, a mobile station radiates in the direction of the sky with a minimal elevation angle of 20 or 30 degrees. An antenna gain of approximately 5 dBi results from that, so that a transmitter power of 40 Watts PEP suffices, which is relatively easily generated nowadays using transistors.

Alternatively, a small helix antenna for a handheld could easily provide 11 dBi, thus requiring a transmitter power of only 10 Watts PEP. From these numbers, we see that we can achieve a 20 dB noise margin on the upward link to the satellite. Considering that P-III-D is planned for the last decade of this century, it is entirely probable that manufacturers will offer appropriate equipment and antennas costing no more than the present 2 meter or 70 cm SSB equipment.

Frequently, on the uplink, the operator uses too much transmitter power, which causes the transponder to reduce its gain. This in turn forces all stations to increase their power unnecessarily. We can assume that incompetence, indifference, and poor receiving installations are the primary reasons operators do not observe AMSAT's power recommendations. We have therefore come to the opinion that it is imperative to add certain technical features to the transponder in order to foster better understanding of satellite operation. As a reminder, the transponder in OSCAR-10 is almost always reduced in gain by approximately 15 dB; even on the QRP days, the limiter voltage is scarcely any less.

In other words, if all stations would reduce their power by a factor of 30, their strength would not change one whit. Weaker stations would then also have a chance to use the satellite. In our experience, it appears that appeals to self-discipline are quite futile.

LEILA

Back during the time of OSCAR-7, a concept was already being discussed at AMSAT-DL which we named LEILA, for "LEIstungsLimit Anzeige" (Power Limit Indicator). This is a type of spectrum analyzer which searches out the strongest station in the pass band of the transponder and then, when the limiter voltage exceeds a prescribed value, inserts a special CW marker signal over this station. Today, with the onboard computer, it's relatively easy to implement this concept. In fact, it is possible to go beyond merely marking an excessively strong station by actually attenuating it immediately with a tunable notch, to prevent degradation to other signals.

In practice LEILA will operate as follows: when an inordinately strong signal appears in the transponder, it will be covered with a characteristic CW pulse. The station should then reduce power until the CW pulse disappears, resulting in the optimal power level. If a station is too strong, the notch filter quickly reduces power.

Due to the characteristics of the notch filter, the signal will sound "odd," in addition to having the marking pulse. In this case a reduction in power by a factor of at least 20 is warranted.

Since LEILA's spectrum analyzer is controlled by the onboard computer, several stations can be managed simultaneously. Suitable software can doubtless be created such that limiting in the transponder can be virtually eliminated. We have therefore definitely decided to include LEILA as a component of P-III-D. This measure along with the high antenna gain should assure that the satellite is truly accessible on a continual basis, even for QRP stations. One other point that needs to be mentioned is that through computer control, special frequencies may be allocated a higher power level, thus providing preferential channels with exceptionally strong signals for emergency communications under difficult circumstances, without degrading the remaining communications to any significant extent. We hope that all users of the satellite will profit from LEILA. (The losers will be the manufacturers of superfluous amplifiers.)

The Satellite-Earth Radio Link

While the noise margin on the upward link is determined by the effective radiated PEP power of the ground station, the satellite's average power per user is the appropriate measure on the downward link. When the average output power of the transponder is 50 Watts, this means that each of 100 active channels has 0.5 Watts available.

For SSB, the peak power (PEP) is approximately 10 times higher, i.e., the transponder provides nearly 5 Watts peak power per channel. Although this adds up to 500 Watts for the 100 channels, and the transponder is capable of 200 Watts PEP maximum, this is no problem since not all channels require the peak power simultaneously. Even for as few as 10 channels, the fluctuations average out to the extent that the transponder can provide practically any peak power level to a single channel.

At 435 MHz and 37,500 km distance, the path loss amounts to 177 dBii. With an antenna gain of 15 dBi at the satellite and 0.5 Watts of power per channel, the effective radiated power of the satellite is 12 dBWi, resulting in levels of −165 dBWi or −160 dBW into a 5 dBi antenna on the ground. The noise power in the receiver is again assumed to be −170 dBW.

This results in a 10 dB average noise margin, or 20 dB S/N PEP. The links to and from the satellite thus provide the same 20 dB noise margin for the minimal station setup assumed. Even considering that both noise magnitudes accumulate, and that small additional losses are unavoidable, the PEP noise margin should not fall under 15 dB; thus easily readable signals are available to the amateurs.

In practice the two links will always differ by a few dB. For anything more than the minimal investment on the receiving side, the upward link will nearly always be the poorer one. The system therefore works at a level where an even larger satellite could no longer boost the achievable noise margin.

Special Aspects of the P-III-D Satellite

The Orbit: Because of the low inclination angle of OSCAR-10, a completely false impression of the capabilities of an elliptical orbit has unfortunately developed in many minds. When the orbital plane is inclined approximately 60 degrees, both orbits are accessible at our latitude during a single day. In addition to the commonly known pass in a southerly direction until overhead, the second daily pass is heard in the northerly direction. In a manner of speaking, one looks past the North Pole to the other side of the Earth. Consequently there are only two brief interruptions of operation daily, while the satellite passes through perigee.

Long-Term Orbit Corrections

In P-III-D an electrically powered thruster will be incorporated which will permit alterations in the orbit even after operation commences. The orbital period can thereby be set to exactly 12 hours, so that the orbit is exactly repeated day after day. Unfortunately, the East-West drift of the ascending node remains unaffected, resulting in the geometry of visibility changing during the course of a year. Alternatively, there is also the possibility of positioning the longitude of the ascending node, which, however, precludes the orbit from remaining synchronized with the clock. At this time it is still uncertain whether these two measures can be combined; there will surely be a few surprises when we tweak the orbit. The orbital control presupposes an electrical thruster, as mentioned.

The Antennas

The original P-III-D design implements antennas with approximately 10 dBi of gain. At apogee, the furthest distance away from the Earth, these antennas are directed optimally at Earth; at other points along the orbit, the antenna squints past the Earth. As a result, the distance to the Earth decreases, the field strength remains nearly constant over a large portion of the orbit.

Theoretically, it is possible to increase the antenna gain to around 18 dBi. Higher gains are not possible since the main lobe becomes too narrow and no longer encompasses the entire globe. As a consequence of such a high gain, signals rapidly fall off in strength away from apogee, and only a fraction of the orbit is useful. When an antenna gain of 15 dBi is selected, the conditions improve, but a large unusable portion of the orbit remains.

Since P-III-D is rather large, the opportunity arises to synthesize the antenna patterns such that the radiation pattern can be changed during orbit, providing optimal gain at any given point. Note that all patterns must always be rotationally symmetrical about the Z axis in order to avoid spin modulation. The switchable patterns make it possible for an antenna gain of 5 to 10 dB more than the original P-III antennas.

P-III-D Power Supply

Under ideal circumstances, the solar generator of P-III-D can supply approximately 300 Watts

Target Parameters of P-III-D Communication

Transponder Mode JL:	
Uplink	145 MHz and 1,269 MHz bands
Downlink	435 MHz Band
Transponder power consumption (nominal)	150 W
Average RF output power of transponder	50 W PEP
Output power of transponder	200 W
Antenna gain (70cm & 24cm each)	15 dBi
Bandwidth of transponder	500 kHz
System noise temperature of 24cm RX	300°K
Spacecraft	
Diameter	3 m
Height without antennas	1 m
Mass at launch	400 kg
Available electrical power (nominal)	175 W
Lifetime (nominal)	8 years
Orbit	
Molnija-Orbit with 12 hour period:	
Inclination	63.4 deg
Perigee height	1,500 km
Apogee height	35,000 km

from its 6 square meters of cell area. When you consider a 20% reduction due to aging from radiation and a sunlight angle of 30 degrees, the available power is reduced to a bit under 200 Watts on the 28 V bus. Of that, the satellite consumes 25 Watts for propulsion, position control, and onboard systems, so that at least 150 Watts remain for the transponder. Using this conservative calculation, no limitations on communications should be necessary during most of the satellite's life.

To permit uninterrupted operation during eclipses, the battery should have enough capacity to supply the power of the solar generator for at least three hours. In OSCAR-10, this condition is partially met. In the case of P-III-D, this means that 750 Watt-hours must be stored. We are uncertain whether it is really prudent to provide such a large battery, weighing nearly 40 kg. It is probably more reasonable to select the battery based on the needs of the propulsion system, nearly 400 Watt-hours, and to accept interruptions to communications or reductions in power during the eclipses. On the other hand, there is no longer the capability of storing enough energy during perigee to enable full operation during the remainder of the orbit despite unfavorable sun angles.

Conclusion

As described, stations having only limited antenna gain will be able to use the satellite fully, based on the current design parameters for P-III-D. This will establish satellite communications on a dramatically broader base, since the antenna expense for the first generation of P-III satellites has been the main deterrent to this mode of operation. For the first time, station design for worldwide DX communications via P-III-D will be significantly cheaper than their shortwave counterparts. The modest requirements for antennas will make the satellite attractive to those who cannot erect outside antennas. The transmissions on 23 cm will cause few TVI problems at the relatively low power levels.

The link improvements of at least 10 dB compared to OSCAR-10 and OSCAR-13 are achieved through the size of the satellite and its high transmit power of over 200 Watts PEP.

Additionally, the new antenna concept for switchable radiation patterns and the electronic notch to prevent misuse by strong stations contribute considerably to this design.

After the successful launch and commissioning of the AMSAT OSCAR-13 (P3C) spacecraft, work is now concentrating on this new P3-D project. Final design review is expected this year, including concepts for high speed digital communication, HF beacons, and other services.

Originally AMSAT had expected to receive financial assistance for this development during 1986 from the German Federal Ministry for Research and Technology, but various bureaucratic hindrances have prevented this from happening. We are now hoping to receive this assistance during 1989 so that the work may begin. 73

NEW PRODUCTS

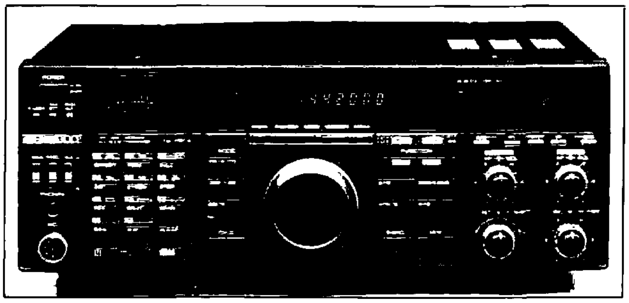
Compiled by Rebecca Niemela

PRODUCT OF THE MONTH

OPTO IAMBIC

ACE Systems' full-featured, compact 5"x5¼"x1½" OPTO Iambic keyer is light enough to take with you anywhere. It contains 7 CMOS devices for high noise immunity and low power consumption. An opto isolator accomplishes keying. Speed and weight controls are adjustable.

The OPTO Iambic keyer is battery powered, or you may use almost any DC power source up to 15 volts. The Power/Logic LED provides you with a continuous status display. Price: $55 plus $3.50 shipping and handling from *ACE Systems, R.D. #1 Box 83, Wilcox PA 15870. (814) 965-5937.* Circle Reader Service number 208.



KENWOOD CORP.

The new Kenwood TS-790A covers 144/450/1200 MHz with enhancements such as Doppler shift compensation for the VHF, UHF, and satellite operator. Automatic Lock Tuning on 1200 MHz eliminates frequency drift. Power output is 45 Watts on 144 MHz, 40 Watts on 450 MHz, and 10 Watts on 12 MHz. For DXpeditions, the TS-790A operates on 13.8 volts DC.

The TS-790A has temperature compensated crystal oscillator circuits, frequency stability of ±3 PPM, 59 multi-function memory channels, multiple scanning and scan stop functions, built-in 500 Hz CW filter, a 10 dB RF attenuator on 2 meters, noise blanker, IF shift, selectable AGC, and all-mode squelch. It also features a packet terminal, CTCSS encoder, dual watch, and voice synthesizer. The TSU-5 and computer control are options. Suggested retail price is $2000. *Kenwood USA Corporation, Communications & Test Equipment Group, 2201 E. Dominguez Street, Long Beach CA 90810. (213) 639–4200. FAX: (213) 604–4487.*

OPTOELECTRONICS, INC.

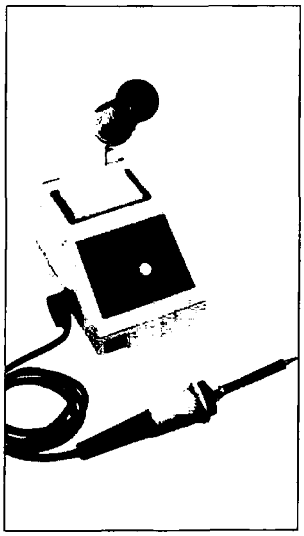
The 2210 hand-held frequency counter from Optoelectronics features a dual crystal oscillator and dual input amplifier design. The low frequency range, down to 10 Hz, has a FET input, high impedance circuit; the microwave range, up to 2.2 GHz, uses miniature integrated circuit amplifiers.

Input sensitivity is less than 10µV, with 3µV typical in the above range. Accuracy is 1 PPM with temperature compensated crystal oscillators. The 2210's size is 3.9"Hx3.5"Wx1"D, and its weight is 9 ounces. Resolution is 1 Hz below and 100 Hz above 12 MHz. The Model 2210 sells for $189, complete with NiCd batteries and charger. A full line of accessories is available. The Model TA-100S Telescoping Whip Antenna is $12. *Optoelectronics, Inc., 5821 NE 14th Avenue, Fort Lauderdale FL 33334. (800) 327–5912 or (305) 771–2051.* Circle Reader Service number 201.

ELENCO ELECTRONICS, INC.

The Elenco electronic temperature control soldering station incorporates a sophisticated electronic circuit which enables the user to change the temperature of the tip from 300°F to 900°F without changing the tip or the heating element.

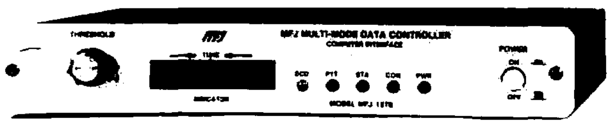
With a sensor near the tip, the temperature is maintained within 10°F of its preset temperature. The tip is isolated from the AC line by a transformer. Low voltage (24 volts) powers the heating element. Electronic switching protects voltage and current sensitive components against any spikes caused by other units. The electronic soldering station incorporates a linear LED array readout which displays the temperature of the tip. Price, $169. *Elenco Electronics, Inc., 150 W. Carpenter Ave., Wheeling IL 60090.* Circle Reader Service number 205.



MFJ ENTERPRISES, INC.

MFJ announces several new modes and enhancements for the MFJ-1278 Multi-mode Data Controller. Navtex receiving and AMTOR transmit and receive have been added to packet, RTTY, WeFAX, SSTV, CW, ASCII, and Contest Keyer Modes. Two features, Easy Mail™ and a new KISS Interface for TCP/IP compatibility, have been added to the packet mode. The price for the MFJ-1278 is $250.

The MFJ-1278 Starter Pack with software for the Macintosh and interface cable with instructions, sells for $20. Existing programs for the IBM (MFJ-1284) and Commodore (MFJ-1282 disk/MFJ-1283 tape) with cable and instructions remain available for $20 each. *MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762. (601) 323–5869. FAX: (601) 323–6551. Telex: 53 4590 MFJ STKV. (800) 647–1800.* Circle Reader Service number 203.



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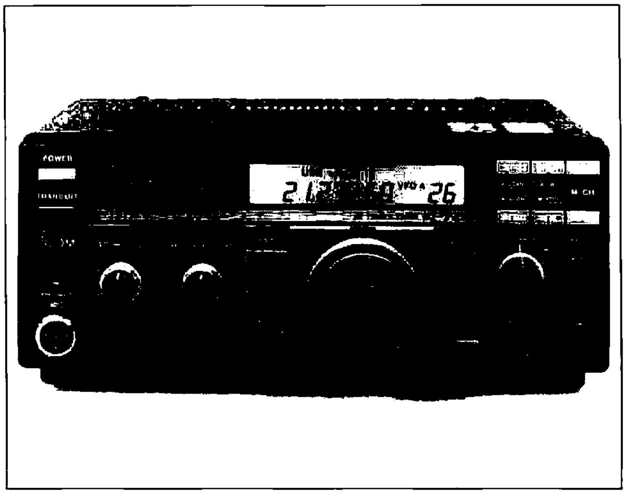
The VOICE-ID was designed for repeater identification, security systems, annunciators, monitoring systems, computer terminals, paging systems, robots, talking signs, and video game sound effects. Price, $150. Shipping/Handling, $5. UPS ground, FOB Davis, California. Prices and specifications subject to change without notice. *Time Domain Systems, Electronic Speech Products, 5003 Cowell Blvd., Davis CA 95616. (916)75–VOICE. (916) 758–6423.* Circle Reader Service number 207.

ICOM AMERICA, INC.



ICOM's compact IC-725 HF transceiver measures 9"Wx3.7"H x9.4"D. It receives and transmits on USB/LSB/CW, and also receives on AM. It has 26 tunable memories with Band Stacking Registers, two-memory channels, and memory for split operation. The three scanning systems are programmable scan, memory scan, and selected mode scan.

The IC-725 has a built-in AH-3 controller, priority watch monitor, 105 dB range receiver, and low-noise Direct Digital Synthesizer (DDS) switching. Operation ranges from 160 through 10 meters, with shortwave reception from 30 kHz to 33 MHz.

Other features include panel selectable RF preamp and attenuator, dual VFOs, noise blanker, RIT, semi-break in CW, and selectable AGC. Options available. Suggested retail price, $949.

The new AH-3 HF automatic antenna tuner is an option for the IC-725. The AH-3 adjusts immediately to the minimum SWR; it has eight memories for quick retuning. It emits 300 mW during tune-up, eliminating interference to other stations. The housing is durable acrylic sealed with rubber gaskets. No adjustments, no assembly; just connect the cables. Suggested retail price, $489. *ICOM America, Inc., Corporate Headquarters, 2380 116th Ave. NE, PO Box C-90029, Bellevue WA 98009-9029. (206) 454–8155. Service: (206) 454–7619. Telex: 152210. FAX: (206) 454–1509.* Circle Reader Service number 204.

The AMSAT-NA Microsats

Four new miniature hamsats.

by Courtney Duncan N5BF

When the European Space Agency launches the SPOT-2 mission this summer, six new amateur radio satellites will be on board. They will all fit on a newly developed mounting ring around the base of the Ariane payload area. This is the largest group of amateur satellites on the same launcher since 1981 when Radio Sputnik's 3 through 8 were put up by a single rocket.

Operators whose experience dates back to the days of OSCAR 8 and the RS-3–8 salvo will recognize certain features of the intended missions and orbits. These six new satellites are, however, state-of-the-art and up-to-date in every way.

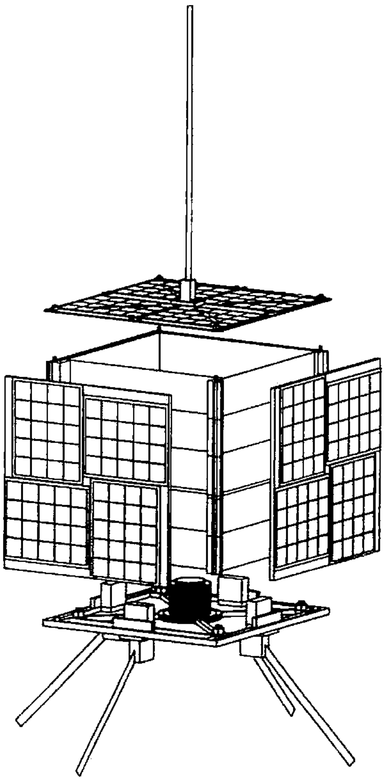
The University of Surrey, the builders and operators of UoSAT-OSCAR 9 and UoSAT-OSCAR 11, is providing two of the new satellites. UoSAT-D and UoSAT-E continue the tradition of low-end scientific research using amateur radio in orbit. These missions are covered extensively in other articles in this publication.

The other four are the first of a new series of spacecraft designed and produced by AMSAT-NA and built around a common bus called Microsat. This standard bus consists of five modules stacked up like cafeteria trays and bolted together. Four of the modules are standard equipment on each satellite: transmitter, receiver, flight computer, and power system. The fifth module is reserved for special "customer" payload applications and is known affectionately by the handle "TSFR" or "This Space For Rent."

Each Microsat stack is a cube about nine inches on a side with solar cells on all six faces. A canted turnstile for the transmitter is mounted around the "bottom." A whip for the receiver sticks out the "top" (see Figure). The power budget allows for a maximum transmitter power of four Watts which will allow easy, adequate reception by ground stations using simple, fixed antennas.

Each flight computer consists of a V-40 and can contain up to 10 Megabytes of memory (in the initial incarnation). These computers will run a multi-tasking operating system that emulates MS-DOS. This approach is intended to simplify software development, maintenance, and simulation on readily available personal computers. Due to a number of clever and creative hardware design decisions, several hundred telemetry and other spacecraft operating parameters will be available to command and monitoring stations.

For more information on the spacecraft monitoring and operating team, contact Ralph Wallio WØRPK, 1240 Highway G24, Indianola IA 50125.



Exploded view of a microsat. Note the five tray frame stack. The receiver module is in the top-most tray, and the transmitter module is in the bottom-most. The three inner trays are power module, computer and "TSFR."

Cylindrical section at bottom is the spring housing, which contains the spring to eject the microsat from the launcher and into orbit. The arrangement is different on DOVE and WEBERSAT.

Orbit Access Times

The orbit for the SPOT-2 mission is specified as sun-synchronous polar (inclination 97 degrees) with an altitude of 822 kilometers, period of about 101 minutes (similar to the orbit of OSCAR-8), and ascending node around 2230 local time. (Note that local time is solar time at a given longitude which may be up to an hour different from local time, or two hours during daylight savings.)

This means that for each satellite, overhead passes will last 15 to 20 minutes. At temperate and equatorial latitudes, there will be two to four passes each morning and two to four each evening in a three to four hour window centered around 10:30 AM or PM. Passes before 10:30 occur to the east, after 10:30 occur to the west, and near 10:30 are near overhead.

Stations at higher latitudes will have more access to the satellites. Because the orbit is polar, each orbit (and there are 14 per day) takes each satellite near each pole.

Although each of the six satellites are placed into the same orbit, they are each deployed in slightly different directions from the launcher body. The resulting slight difference in actual velocity will cause them to spread out all around the orbit circle in just a few days, as happened with the RS 3-8 satellites.

To visualize this, imagine a ring around the earth going from pole to pole and crossing the equator over a place where the local time is 10:30. Six satellites are spread out at random along the ring. As was observed with the RS 3-8 satellites, an operator under the ring of the orbit (that is, where it is late in the morning or evening) will not have to wait long for a satellite. As the six satellites drift around with respect to each other, they will appear individually or in groups of two or three, changing patterns from day to day. When one sets, another will be up, or will be about to rise. In between nodes (several hours around 4:30 AM or PM local time), passes are not possible for any of the group.

A Co-operative Effort

The AMSAT-NA team is not building the Microsats on their own, nor will they be operated solely by and for North Americans. To the contrary; several groups are participating in the development of the Microsat bus and will separately (but co-operatively) own, license, and operate them. These groups and their leaders are:

AMSAT-NA; Doug Loughmiller; PACSAT
Weber State College, Ogden, Utah; Robert Twiggs; WEBERSAT
BRAMSAT; Jr. DeCastro; Project DOVE (Digital Orbiting Voice Encoder)
AMSAT-LU; Carlos Huertas; LUSAT

AMSAT-NA is the Amateur Radio Satellite Corporation, North America. BRAMSAT is the AMSAT of Brazil and AMSAT-LU is the AMSAT organization of Argentina. Also, The American Radio Relay League (ARRL) and Tucson Amateur Packet Radio Corporation (TAPR) are each providing considerable assistance with development.

Nominal Operating Frequencies

Mission	Downlink	Uplinks
PACSAT	437.050 MHz	145.900, 145.920, 145.940, 145.960 MHz
LUSAT	437.150 MHz	145.900, 145.880, 145.860, 145.840 MHz
WEBERSAT	437.100 MHz	
DOVE	145.970 MHz	

PACSAT and LUSAT are orbiting packet radio mailboxes. These build on and significantly expand the Fuji-OSCAR 12 mode JD (digital) mailbox tradition. They will not function as digipeaters. The intention for these missions is to allow worldwide access to packet mail messages, to bring the amateur digital and satellite communities closer together, and to improve the response of the packet mail forwarding system. Access will be via the exact equipment that has been used to access Fuji-OSCAR-12, a packet radio TNC (terminal node controller) and associated computer terminal, a 2 meter FM radio for transmitting, and a 435–438 MHz sideband receiver connected with a phase shift keying demodulator for reception.

Since packet radio functions are computer-intensive, a powerful computer is included with each Microsat as standard equipment. That is the only payload. The TSFR module is flown empty on the pacsats, or will contain additional digital transmittals and receivers.

The Digital Orbiting Voice Encoder (DOVE) will continuously transmit stored digital voice messages on 2 meter FM as it orbits. This operation will be similar to that of the digitalkers on UoSAT-OSCAR-11 which aided the recent Skitrek polar expedition by providing navigational information for the group moving across the ice, and for educational listeners around the world. Ground operator equipment for DOVE consists of only a 2 meter FM receiver or scanner with a simple antenna.

The payload module on DOVE contains all the special equipment for producing audio for the FM transmitter. There are three audio sources, a digital synthesizer, digital-to-analog converters so that any sampled sounds can be played back, and Bell 202 standard modem tones for limited telemetry transmission.

DOVE is considered largely educational, to provide inexpensive and simple access to satellite communications and science, technology, sociology, geography, languages, and other subject matter. High school students worldwide are submitting messages for DOVE. For more information and teacher's kits, contact *Richard Ensign N8IWJ, 421 North Military, Dearborn MI 48124.*

The WEBERSAT also uses packet radio and frequencies similar to those on the pacsats, but its mission is somewhat different. The WEBERSAT payload module contains scientific experiments and a color TV camera! TV pictures will be digitized and compressed, then broadcast as binary files on packet "unproto" beacon frames. These may then be collected and reassembled by monitoring stations on the ground. WEBERSAT will also contain a spectrometer and an L-band wideband receiver for direct uplink into memory of fast scan TV pictures.

For more information on participation in WEBERSAT experiments, contact *Robert Twiggs, Director, Center for Aerospace Technology, Weber State College, Ogden UT 84408-1805.*

AMSAT-NA already has a working agreement with AMSAT-Italy to provide plans and assistance with construction of a pacsat Microsat under Italian jurisdiction. Launch of this mission is expected next year. AMSAT anticipates many similar working agreements, both amateur radio and commercial in nature, for the Microsat bus over the next several years.

Projects For Ground Stations

A number of projects, some technically challenging, others routine, will be available to amateurs and UHF listeners wishing to participate at some level in the operational programs for these satellites.

The pacsats, for example, will start out operating in a mode similar to that used by FO-12. Stations will randomly compete for each of the four FM uplink channels on 2 meters while everyone listens on the PSK downlink for responses, traffic, and information or telemetry beacon packets. This is really not an optimum method when the uplinking user base in view of the satellite exceeds a handful of stations. Many improved access techniques will be proposed, discussed, and tested on the pacsat missions. The access protocol dialogue is far from finished.

Techniques for using the pacsats for packet mail forwarding and improvement of the forwarding network are also under consideration. Mail forwarding protocol changes implemented for pacsat operation will also help the terrestrial forwarding circuits.

Each Microsat using packet radio will have the ability to select between 1200 and 4800 baud on any combination of uplink and downlink channels. Assembling and operating a ground station for 4800 baud operation will be a challenging project worthy of the best operators in the AMSAT tradition. Functioning stations will also provide much needed gateway, linking, or high speed forwarding resources, if desired.

Digitized video is a popular topic in amateur radio recently, and WEBERSAT will be a strong participant in testing and developing standards both in space and in diverse ground stations.

Rod Magnet Stabilizing

Spacecraft stabilization is an interesting area of investigation. The Microsats are each stabilized by rod magnets mounted parallel to the Z axis of the spacecraft. These magnets try to align themselves with the earth's magnetic field as the spacecraft orbits, so the spacecraft's Z axis rotates twice per orbit. Photon impacts on the canted turnstyle causes the satellite to rotate about its Z axis with a rotation period of minutes. The turnstile antenna blades, which are painted black on one side and white on the other, generate torque. Lossy ferrous material mounted in the X-Y plane damps rotation.

The Z axis magnets, by the way, are being mounted in PACSAT and LUSAT in opposite senses so that if there is any favoritism between hemispheres in this stabilization approach, one pacsat will favor the northern hemisphere, and the other the southern hemisphere.

Although this stabilization technique is well understood and was used very successfully on AMSAT-OSCARs 7 and 8, it has not been thoroughly analyzed and quantified. An understanding of the spacecraft's attitude can help users understand and predict antenna patterns, thermal activity, and solar cell illumination. A predictive model of spacecraft attitude is particularly useful for WEBERSAT, so that users can know when to take pictures with the camera! Conversely, you can use the camera to confirm WEBERSAT's attitude and to refine the predictive model.

We can do much to collect data on the demographic peculiarities of the Microsat missions. The pacsats can collect part of this data automatically by tabulating successful interactive packet exchanges. Reception reports from all Microsat listeners will provide complementary information for optimizing future plans.

We can use experiments to determine ionospheric and other propagation effects on the digital uplink and downlink signals to determine an optimum set of AX.25 parameters for each link and data rate.

These experiments are interesting and educational and help fill out AMSAT's understanding of its own projects. Some are crucial to mission success. In most cases, all or nearly all of the equipment necessary for participation, is already present in an OSCAR station equipped for mode JD, as described above. Of course, the orbiting packet mailboxes can handle the announcements, bulletins, and electronic-mail correspondence among participants.

Exact orbital information and mission status will be available from AMSAT after launch.

This article has presented a brief overview of the imminent Microsat missions and challenging experimental programs. The list is by no means complete, but is merely a sample of the exciting opportunities about to become available.

Join AMSAT

For further general information, or for more information on operational projects, join AMSAT and contact *Courtney Duncan, Vice President, Operations, AMSAT, PO Box 27, Washington, DC 20044.* AMSAT publications cover the technical issues surrounding the amateur satellites and their use in great depth. Members also receive periodic progress reports. We encourage your AMSAT membership and participation! ■

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MACINTOSH, ATARI XL/XE/ST, & AMIGA Amateur Radio software. We have several public domain disks available for trade or $4.00 each. Send business size SASE specifying computer for list. Write WA4EFH, PO Box 1646, Orange Park FL 32067-1646. BNB877

WANTED: All types of Electron Tubes. Call toll free 1 (800)421-9397 or 1 (612) 429-9397. C & N Electronics, Harold Bramstedt, 6104 Egg Lake Road, Hugo MN 55038. BNB878

FOR SALE: Full size schematics. Complete sets for Ranger 4R 3300—$20.00, Ranger AR 3500—$25.00. I.Q. Advertising, 1405 Stevenson Dr., Suite 3 No. 694, Springfield IL 62708. BNB879

IBM PC, XT, AT, AND COMPATIBLES. Transmitter keyer and code practice program. Features: keys any transmitter, menu driven, 1000 character type ahead buffer, 22 programmable messages, 1-100 wpm (plus selectable speed modifications), selectable practice programs, manual, and much more. Nothing Compares. 100% Moneyback Guarantee. $19.95. Same day return. Lloyd Wilson, 4464 N. Lakewood Dr., San Bernardino CA 92407. BNB880

Continued from page 18

There should be eight holes per leg, totaling 64 holes. These holes will help you to attach the screen wire to the spokes with pop-rivets.

Cut eight pie-shaped pieces of screen wire so that they overlap each section of the dish by at least three inches. Then attach the metal screen wire to the spokes with ⅛-inch pop-rivets. If you've never used pop-rivets, don't be afraid; they're cheap and easy to use. It's a good idea to place a small CAD washer under each rivet to increase the holding area. Start by securing the edges of two screen pieces to the first spoke in an "overlapping leaf" technique (sort of like placing two pieces of a pie next to each other). Then, moving one section to the right, secure the previous screen section and the next to the second spoke. Repeat the process until all eight sections are attached.

There will be some leftover screen hanging over the perimeter. Fold this over the 16 gauge wire and then cover it with eight pieces of very thin sheet aluminum angle stock (sold at hardware stores for covering sheetrock when it is joined together in outside corners). This thin right angle stock comes in 8-foot sections and sells for under one dollar.

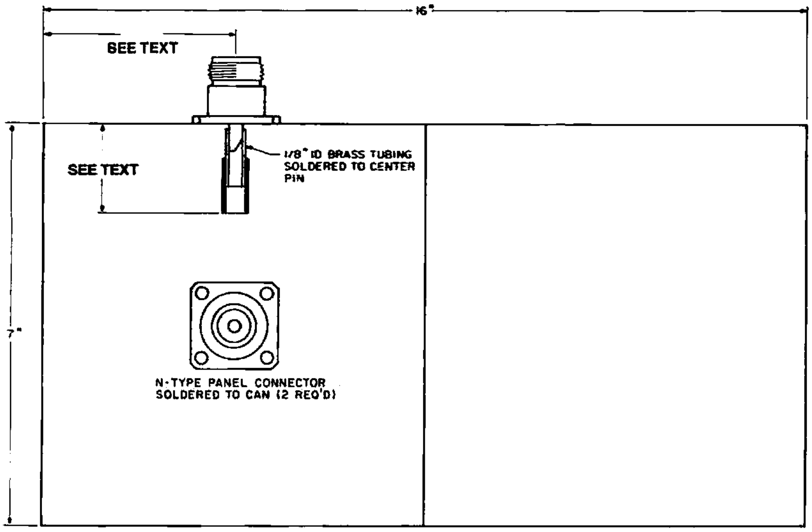


Figure 4. Coax-to-waveguide adapter.

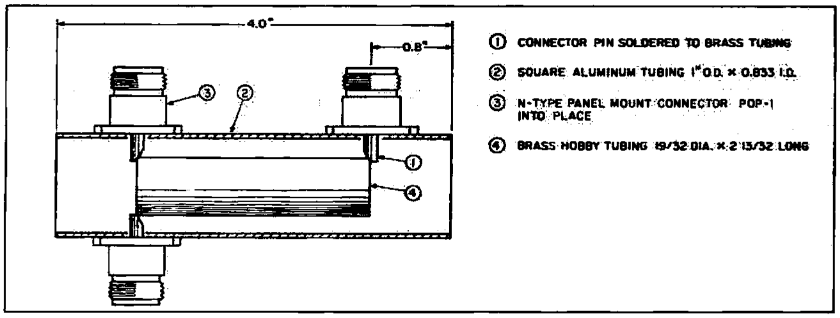


Figure 5. Power divider.

"For OSCAR-13 work you will need right-hand circular polarization (RHCP)."

The Feed

The best parabolic reflector in the world would be useless if it weren't fed properly. The feed I chose boils down to a big coax-to-waveguide adapter (see Figure 4). The waveguide consists of two 7-inch diameter cans that I found in a craft shop. (I think they were originally meant to hold flour.) I used a can opener to remove the bottom of one can, and then soldered the two cans together to produce one big can. Next, at the correct point from the rear wall, I soldered two N-type panel connectors to the outside of the can, 90 degrees apart. Then I attached a small one-inch long piece of ⅛-inch I.D. brass hobby tubing to the center conductor of each connector, and slid a 1.5-inch piece of the next size up brass hobby tubing over the former piece to allow tuning. I tuned each feed individually with a Bird wattmeter to get a 1:1 SWR. Once you have determined the correct length, you can solder the outer tube into place. I was amazed at how easy it was to tune the antenna, and how broadbanded it was.

If you don't want to use this method, you could solder a single piece of large diameter copper wire to the N connector, and prune it to the correct length for best SWR. This should work acceptably, at the expense of some bandwidth.

For OSCAR-13 work you will need right-hand circular polarization (RHCP), so make two feeds into the same waveguide. If you feed one probe 90 degrees out of phase to the other, you will generate circular polarization. When a signal from the feed antenna hits the parabolic surface, the polarization will be reversed. So, in order to generate RHCP, you must first produce LHCP. The power divider shown in Figure 5 will accomplish this. This power divider is nothing more than a ¼ wavelength piece of 35.7Ω coax that transforms 50Ω down to 25Ω. You want 25Ω because that is what results when the two 50Ω feed antennas are hooked up in parallel. Add an extra ¼ wavelength of 50Ω feedline to the left-most feed (as looking from the backside of the can) to produce LHCP. Be sure and take into account the velocity factor of the cable when measuring this.

Mounting The Feed Horn

Attach the feed horn to a two foot piece of wood 2 x 2, which is in turn bolted to a one foot piece of ½-inch O.D. pipe (Figure 5). Offset this whole arrangement from the center 3.5 inches by using right angle pipe joints. The feed horn should end up directly over the center of the dish and two feet above the surface (corresponding to a 0.4 F/D). Use wood to minimize the interaction of the feed antenna with the mounting hardware.

Installation

The 1-inch floor flange on the backside of the dish is placed there to accommodate a piece of one-inch pipe. The length of this pipe will depend on how you want to mount your antenna and how much you need to counterbalance it. Each installation will be different, so good luck!

Test and Results

As of yet, I have not permanently mounted the antenna next to the other OSCAR antennas. I've only manually pointed it "Field Day" style. I think that I'm going to have to get a bigger elevation rotor. With 10 Watts to the antenna I can consistently hear my own signal close to the beacon in strength, and on-the-air reports from others are favorable.

This article was written to show how I built this antenna cheaply with the materials at hand. I'm sure that I could have done things differently as I know you may choose to do, depending on the availability of materials in your area. Be innovative and use construction materials that are probably all around you now.

My thanks to K5SXK who patiently explained antenna theory to me and answered questions whose answers I should already know. See you on the satellites! ■

Number 28 on your Feedback card

LETTERS

From the Hamshack

Packet Racket

An electronic plague has descended upon amateur radio. Long-standing nets and discussion groups have been pushed out of existence by the agonizing, screeching tide of packet racket. Large numbers of those who might well be the majority in our hobby now find it impossible to monitor their favorite frequency because a packet station has plopped down on it or near it. Who can stand that piercing sound that has been likened to fingernails on a blackboard?

A typical example is found when monitoring 144.9 MHz. This frequency has been used for fast-scan TV liaison for over thirty years. It is important for signal reports, homing-in antennas, and guiding transmitter/modulator adjustments. An S-9 packet signal on 144.905, while not even moving the meter on adjacent channels, breaks through and can be heard 10 kHz up and down. The worst part is that the RF burst lasts longer and blocks all but the strongest voice signals on 144.9.

When packet was first announced, it was described as the ultimate in space age technology. Economy in use of the spectrum was the keynote in this discussion due to its inherent speed and accuracy. This allows a large number of operators to be serviced by one system. What it really amounted to in many cases was a new justification for having spent hundreds of dollars on a computer that started gathering dust after the novelty had worn off. Although most hams can talk well, and many can even chew gum at the same time, this great store of wit and wisdom had to be digitized, dehumanized, and stored in libraries called bulletin boards. I guess it goes along with the inability to listen and write.

In any case, the basic pleasures of amateur radio—hearing a voice from afar, sensing its emotions, its unique sounds, are being bittered. It is bad enough to lose frequencies to commercial interests, but it is much worse to have them rendered unlistenable by your own group. This could be the final assault in which amateur radio, like all the great empires, falls from within.

John Shelley WA1IAO
N. Granby CT 06060

John, it's clear to me you haven't bothered to really check out what packet's all about. First, the packet invasion on 2m is really 5–7 packet channels, taking up 100 kHz of bandspace—2.5 percent of amateur allocation on that band. You'll find the same modest subband for packet on the HF bands—there are again 5–7 channels on 20m, for example, that take up around 15 kHz of the band—about 4% of our allocation on 20m. This hardly constitutes an "assault."

A single AM voice signal—the voice mode with the minimum bandwidth where you can really sense the richness of nuance and emotion in another op's voice—takes up half the total packet subband on 20m!

Packet is indeed a frequency economical mode—and it rose in part out of a desperate need to economize band space. Most bands—in HF especially—are now jammed with activity, most of which is still voice and CW. The basic pleasures of amateur radio about which you speak—the voices from afar, the emotions, the sounds—are more and more our agonies; the voices of weary DX stations dealing with obnoxious pile-ups, exasperation, and constant mutual QRM. A clear voice channel on 20m nowadays is truly unique!

One of the things that made amateur radio a great empire was that hams were at one time on the leading edge of radio communications development. We embraced new modes such as FM and SSB when they came along. Who then balked about the monotonal quality of SSB as compared to AM?—the important thing was that it allowed a greater range and cut signal bandwidth in half!

The introduction of new modes to amateur radio, and the low-cost R&D performed on them by thousands of hams, is a blessing. This is a continuing justification of our existence to the government. Packet, too, does an unparalleled job with another one of our raisons d'etre*—traffic handling. What other mode do you know that can handle traffic, error-free and unattended, at many times the rate of CW, or even voice? Visit a VHF packeteer's shack some time late at night and watch the stream of automatically routed NTS traffic scrolling across the monitor—keeping a band active that is often times nearly dead in the late hours.*

If amateur radio falls from within, a large part will be from our overriding nostalgia preventing us from learning new modes.

. . . de NS1B

Sorry, Wayne

Sorry to inform you I have upgraded to Tech and have been working on teaching a new Novice who is almost ready for the test. So you don't get to rip up my license for failure to upgrade myself and promote amateur radio to others!

If every ham would work with one student each year, we could avoid discouraging people.

Keith Martin
Lewiston ME 04240

Number 29 on your Feedback card

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

The feature item this month is the finalized 73 **[Best Regards] *International Universal Permit Application***, *printed on a separate page. It isn't really finalized, of course—it never can be that, but so long as Hambassadors keep us posted on changes of requirements in their countries, we can keep it reasonably up to date. In its present form it has now been officially accepted by the authorities of* **The Republic of South Africa** *(see under "Roundup," below).*

And speaking of Hambassadors: They come and they go, and in recent months more Hambassadors have been going than coming. How long can "73 International" do its job without wide coverage of the ham world?

What IS that job? Broadly speaking, we see it as keeping strong and bold the S in Amateur Service. One of the major conditions of receiving a ham license is the obligation placed upon license-holders to be of Service to their nations and, since radio waves have no national boundaries, this really means service to the ham world.

We of the editorial staff who all together make up the fictional editor of this column, Chauncey Charles Cuthbraith (the all-CCC-ing C.C.C.), view our job to be of Service to you. Like working for a universal permit application form. For you. But this, and by far most of the information brought you here each month, would never appear on these pages without Hambassadors.

We hope the change in policy had nothing to do with the drop-off (cash payments of $40 for each of four long reports a year have been replaced with a first-class airmail subscription to the magazine for three brief reports each year). There was no way we could expand our world coverage from the initial 38 countries to the current more than 75 and continue under the old policy. Work out for yourself the increased cost to us of up to 225 reports per year, many of which, with a maximum of four pages to use, we would have had to cut in length or not used at all!

And the 75-country coverage is being reduced to only theory right now. It has been too long since we have heard from some countries, and it hurts a little that this includes some with Hambassadors whose subscriptions continue and will continue through 1989. . . If you have to resign, OK, we know how situations can change for anyone. But please let us know so we can recruit your replacement. Remember: Hambassadors are providing Service to each other and the world, and "73 International" provides the space for you.

(We hope all subscription problems were solved by late last year—we fired the company that had hashed up addresses badly. As an example: one overseas address had been computer-mangled into a name, a street address, and a nation. We DO think our Hambassadors are notable, but an address without mentioning the name of a city is asking too much of a postal system!)

Hambassador or not, let us know of changes needed for the universal permit application form to make it acceptable in your country. Hambassadors, please submit the form printed in this issue for an official approval by your country's authorities.

The kind of wording used by the government of South Africa (see box) should be satisfactory.

And now the calendar for May: On the 1st it is May Day (Fete du travail, Tag der Arbeit, etc.) for China, France, Germany, and the USSR (National Labor Day is on the 22nd for Jamaica); 2—King's Birthday, Lesotho; 3—Constitution Day, Japan (17th for Norway); 5—Bataan Day, Philippines; 7—National Day, Chad (Cameroon on the 20th, Tanzania on the 26th); 8—Victory Day, France; Queen's Birthday, Australia; 9—Liberation Day, Czechoslovakia; Independence Day, Israel (Paraguay on the 14th, Jordan on the 25th); 14—Mother's Day (Muttertag, Dia de las Madre, Fete des Meres) USA, Germany, Guatemala (on the 28th for the Central African Republic); Unification Day, Liberia; Joan of Arc Day, France; 15—Victoria Day, Canada; 16—Discovery Day, Cayman Islands; 18—Prayer Day, Denmark; 20—Navy Day, Chile; 22—National Heroes Day, Sri Lanka; Spring Bank Holiday, Great Britain; 24—Bermuda Day, Bermuda; 25—Revolution Day, Argentina; 29—Memorial Day, USA; 31—National Holiday, South Africa.

Roundup

Australia. K.D. (Ken) Gott VK3AJU writes: "My delay in answering [your letter asking if I had notified the WIA of my volunteering to be the Australian Hambassador] was due to my vacation on Erith Island, an unpopulated spot in Bass Strait, 147° 20 E, 39° 30 S, where the fishing is great and the abalone and lobsters are free. (However, the DX is not so great.) The VK news should start to buzz around a lot faster. . . the WIA office holds files of *73* which I have already consulted. So before long you may expect some dispatches from me. . ." [*We look forward to them—and a picture of you, please. (Any Hambassador who has not yet sent us a picture: please send!—CCC*]

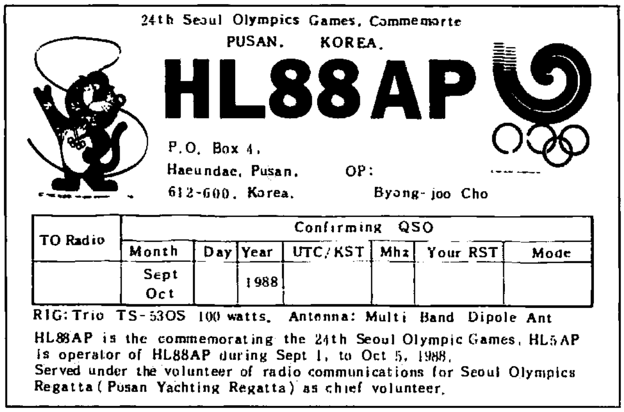
Korea. Byong-Joo Cho HL5AP/HL88AP sends Christmas and New Year's greetings:

더욱 알찬 결실을 맺는
새해가 되시길 기원합니다.

He promises reports in 1989 when construction of "our new home and offices" is finished and he has "set up a new antenna tower and beam." He also sends his and the KARL Olympics stations' (HL88AP and 6K88BYC) QSL cards.

Netherlands. Radio Netherlands program information is available electronically. Dial your international access code, then (31) 35 45395 for the IBM host computer, which will work at 300/1200/2400 baud. It uses the standard 8-N-1 (eight data bits, no parity, one stop bit) format and both CCITT and BELL tones. Alternative methods: In the USA: ANARC (Association of North American Radio Clubs) bulletin board in Peoria IL, (309) 688-0604, or the Pinelands board (Tom Sundstrom) in Vincentown NJ, (609) 859-1910; both use BELL tones and the same format and baud rates as above. If you run a BB and want an electronic feed of Radio Netherlands news, get in touch.

Republic of South Africa. Our Hambassador Peter Strauss ZS6ET sends us the first official approval of the 73 International Universal Permit Application. A photocopy of the body of the letter from the Telekommunikasie Afdeling (Telecommunications Division) of the Poskantoor (Post Office)—see box—makes it official



Councillor D Slegel
South African Radio League
Headquarters
PO Box 3911
CAPE TOWN
8000

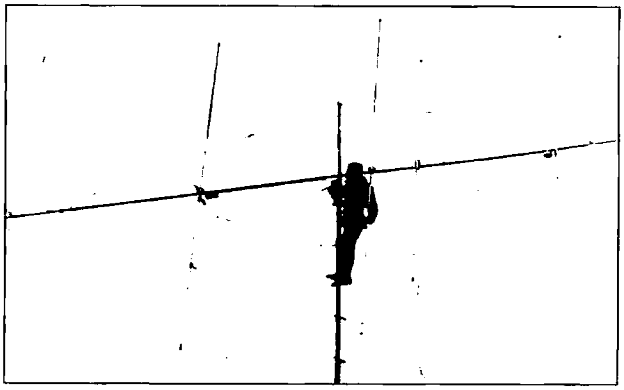
Dear Mr Slegel

RECIPROCAL AND GUEST AMATEUR RADIO LICENCES

With reference to your letter of 16 November 1988 with enclosure 1 wish to inform you that the proposed form by 73 Magazine of the USA appears to embody all the details normally required. Consequently we would have no objection to an overseas visitor submitting such a form when applying for one of the above-mentioned licences.

Yours faithfully

POSTMASTER GENERAL



UA9MI's fullsize 7-el yagi.

as of December 20, 1988 for use by any ham planning a visit to South Africa.

Sweden. 1988 marked the 50th anniversary for Radio Sweden and the 40th for *Sweden Calling DXers* which published its 2000th issue. On December 5th the new language, Estonian, was added. (From Bulletin #2023, 12/27/88.)

CYPRUS

Aris Kaponides 5B4JE
PO Box 1723
Limassol
Cyprus

News From Cyprus. HF radio amateur activity in Cyprus seems to be stabilized. About a dozen amateurs come regularly on the air on the HF bands, mostly on phone. Two or three are regulars on CW, with Loris 5B4FN leading the group. Very timidly, the first packeteers on HF have made known their presence in this new and exciting mode. OM Costis 5B4TX is pioneering, and 5B4FN, Akis 5B4OA, and George 5B4MDD, in the Nicosia area, are starting to be active. Nicos 5B4CV in the Limassol area is warming up his soldering iron to homebrew the necessary packet TNC and interface.

From the ZC4-side, I can copy only the Akrotiri and Epikopi base areas, and as far as I know from the old ZC4s, Alan ZC4AB is specially active on 10 meters. Bill ZC4WK will be a new station heard from this year, the club station, ZC4EPI will be reactivated, and there are another five or six ZC4 stations on the island but I have no information on their activities.

On the VHF side, CARS has decided to use the private line system on all the Cyprus repeaters to counteract the QRM from the various nonlicensed operators from Lebanon.

On the social side, a Christmas Dinner Dance was held in Nicosia and amateurs from all over the island gathered there with their families and had a terrific time!

Cyprus is a holiday island, and we do get our fair share of ham visitors. I had in my shack Rudi DJ0MAF and Tony G7ATA, and Michel GJ6WDK and Bjorn SM7ED were here. Last summer I again had my friend Jim GM4HKW and his XYL Hilda. Other 5B4 hams had also foreign ham visitors in most parts of the island. Little Cyprus seems to be doing her best to promote the amateur radio aims and objectives. Hi! [*OK, Hambassador Aris, can you get the new universal permit application form officially approved?!—CCC*]

USSR

From Mike F. Shakirov UA9MI
PO Box 2056
Omsk 644119, USSR
via Ken Carpenter KC4UG
PO Box 586
Vernon, AL 35592

[*KC4UG writes that the envelope from UA9MI arrived open and two of the three pictures were missing. He also wrote, "I find the 73 International column very interesting and always read this just after Wayne's editorial." We'd say that in this case being second is as good as being first!—CCC*]

Hello! I'm greeting readers of "73" journal! I'm teacher by profession and have not much free time, but devote good deal of it to ham radio. It is many-sided and therefore has many admirers [everywhere] and in Omsk, too. Equipment and antenna designing is my hobby, only home-made is my principle! Working on the bands I prefer zero degree azimuth beam direction because I find American hams great gentlemen in operating and I like to work with them.

As I write these lines, our country has a disaster—the earthquake in Northern Armenia. Like many other ham radio friends I try to do everything I can in the transmission of the information by ham radio canals [channels]. A group of three from Omsk, including chief - UA9MA, G. Kolmakov, is in Stepanovan now and keeping in official touch. I have many QSOs with special stations from Armenia.

[*The missing pictures were of UA9MI and his station, and a 2 kW linear amplifier of his own design. Maybe he can send replacements? About the third photo, he wrote that a maintenance check was being performed here, before the 1987 WW Contest, in −25 C temperature, 40 meters off the ground, with the wind 15 M/S!—CCC*]

Continued from page 6

helped build international friendships? Have you helped us get more newcomers? Or will the only sign that you ever existed be a listing in old *QST*s in the Brasspounder or DX Honor Rolls? What an ego-starved waste of a hobby which has such an enormous potential. Oh, I enjoy working DX, but I haven't the vaguest idea of how many countries I've worked. I stopped counting at 300 years ago, and even then I never submitted cards for "credit."

Some hams go into business making ham products. Yes, I suppose they have daydreams of making big money. A few have, though not often on ham products. The ham business never did much for anyone by itself—it was the growth into the more commercial markets which brought on real success.

Art Collins W0CXX did well when his ham SSB gear was accepted by the military. Yes, he used amateur radio as his entry into this market, with the help of Don Merten W2UOL. I'd sure like to see the inside story published—fascinating, if rather seamy in places. But that just makes the story more interesting.

Ham History

There's a lot of ham history which needs to be written before all you oldtimers who were there die off. It'll never be published in *QST*, but I'd go for it.

When will someone write a biography of Mort Kahn W2KR? His success with Tempco, which he sold to Otis Elevator for a few million dollars—then his clever bulldozing his way into the job of Hudson Division director, from which spot he got rid of Bud Budlong W1BUD, the League's long time alcoholic and arrogant general manager. He also organized the building of the new HQ building. On the downside, he was deeply involved with the terrible Hallicrafters scandal at the New York World's Fair and, even worse, was the main engineer of the devastating Incentive Licensing disaster.

There must be someone left from that meeting on Mort's yacht on Long Island, in December 1962, where Tom McAnn K2CM came up with the plan for Incentive Licensing—a plan to return amateur radio to its pre-WWII license system and frequency allocations. A plan which has directly caused America to lose over two million scientists, engineers, and technicians so far—and contributed substantially to the loss of all our consumer electronic industries.

Oddly enough, you don't have to be a genius to leave your footprint in history. You do want to remember that genius is 90% perspiration and only 10% inspiration, so even the most brilliant of ideas are unlikely to get anywhere unless you get behind them and push hard.

Just look at the state of the art in amateur radio today. Here we are still fighting QRM on our HF bands. That's crazy. We have the technology available to get rid of 99% of the QRM—all it takes are some pioneers to make it happen.

Sure, we have the beginnings of packet radio. But it's still far too slow and problem-prone. It needs the help of more pioneers. We want to get packet so it's fast and error-free. We have the technology available to speed packet up to 500 pages per second. Yep, two milliseconds for one full page of information! By using a digitizer, we could input text and graphics from books and magazines, so we wouldn't even have to sit and type everything.

How about it? Will your final mention in Silent Keys be the only way we'll remember you? Or will you find some way to improve amateur radio for us all—for future generations, if there are any? What, if anything, are you doing to make sure there is a next generation?

Are you working with your club to get us more Novices? Or are you doing your best to keep the darned kids out of your old-man's club? Are you spending your life pursuing certificates? Why? Is the Honor Roll your main goal in life? Why? Are these things really the best you can do for the world as a person and as a ham? They ain't much.

I told 'em to try again and I'd see what I could do. I explained that my management style was not to dictate, but to advise. Well, I advised and the *73* staffers ignored—claiming the readers would be angry. They're probably right.

Since even the psychiatrists have a lot yet to learn about homosexuality, there's no way most of us are going to put something as charged as this into any reasonable perspective. Gays have, to some extent, come out of the closet, but their welcome hasn't been warm.

One of my problems in getting along with people has always been my refusal to go along with "accepted" ideas unless they made sense to me. That's worked in my favor in some ways—like smoking. Most of my teenage friends took up smoking. Hmm, so I tried it and said ugh, thereby saving myself an incredible amount of money on cigarettes over the last 50 years—plus accumulating fewer serious health problems. Many of the smokers who served with me on the *Drum* during WWII are already long gone—and most of 'em were younger than me.

"We have the technology available to get rid of 99% of the QRM"

If you can help make our ham history more complete by telling us about the heroes and villains you've known, how about writing an article before you, too, are gone? Perhaps, if we had more of a sense of history, we'd have more ham heroes. How much do you really know about Hiram Percy Maxim, the chap who founded the ARRL? Have you read his books? Pity, if not.

The sunspots are coming—we've got Novices on 10 meters—and we've a world of new technologies just waiting for us to get to them. You do it—you write about it—and I'll publish.

Gay Hams

At the end of my talk at Dayton this year a chap came up to explain that he didn't think anyone would ever convince him that we should get rid of the Morse code as a requirement for a ham license, but after my talk he was converted. I think "converted" is the right term—since it's much more a religious matter than one involving intelligent thought. Perhaps I should rebill myself as Reverend Green. As a Doctor of Divinity in two religions, I certainly have the bonafides. Heck, those DDs cost me $20 each around twenty years ago—one of my well-hidden assets. Hallelujah! Say Amen, brother!

Right after the genuflections of the newly converted Code-Satan contingent, I faced a more formidable group: militant gays. Oh, boy! The leader, working his way up to a petulant seethe, was outraged that *73* had refused a classified ad from his ham radio gay/lesbian group, which was looking for members. First I'd heard of it.

My father, who came from about seven generations of New Hampshire people, was typical of his generation of WASPs—anti-black, Jew, Catholic, and so on. When I started my first business with a sales office in my bedroom at home I hired an assistant. A few days later my father took me aside—my assistant, he was J-e-w-i-s-h, wasn't he? Hmm, guess so, it never crossed my mind one way or the other.

When I was working as a professional psychologist one of my patients was a homosexual. He had some problems with which he needed help, but his sexuality wasn't one of them. Never Say Die, I tried to see what I could do for him. I wish he'd been more interested in finding out where and when it started, but we did go back to his being aware of his sexual feelings for boys when he was three years old, so the psychiatrists are dealing with far more than a behavior problem.

As a straight, the whole concept is repugnant, but that hasn't seemed to interfere with my accepting gays as friends. Indeed, I have never found myself considering that when hiring, or in any decisions on friends. I have some good close friends who I know are gay, though the subject has never come up between us.

So my inclination was to run the ad. It isn't as if a gay/lesbian ham group is going to convert someone to the gay life, so what's the beef? But, I recognize that though in many ways I'm an arch conservative, my liberalism in people could set many older hams off into flights of fury. With the average ham age up around mine, I recognize that in this respect I'm marching to a different drum.

Heck, I hope it won't bug you, but even though I live in New Hampshire, where blacks are almost as rare as wild tigers, I have a good friend who is black. Now that may not sound like much, but when you consider that 99% of my life is spent working, I don't have much time to make and keep friends.

One thing amuses me, speaking of work. I run into people who are suffering burnout. Give me a break! I've worked a schedule few of you could keep up with almost all my life and I'm still not quite burnt out. I've got more plans for new projects than anyone else I know—with modest goals of getting us to over two million US hams, modernizing the American educational system, cutting college costs to virtually zero, ending welfare, and so on.

Yes, I agree my plans are outrageous, but by golly I'm making progress with 'em. Isn't it better for me to have these goals instead of the more normal ones for people my age, such as getting my golf handicap down five points?

So what do you think about our running a classified ad for a ham gay/lesbian special interest group? The whole gay situation is going to be a hot potato for a long time to come. We've seen plays about the shock of parents finding out one of their children is gay. And we know about the jokes around the office about AIDS and gays deserving each other. Many people don't think of gays as being normal—something like being handicapped—maybe like being blind or deaf, but with an even greater element of shame and disgrace.

Amateur radio has always been a friend of the handicapped. I remember the great help Bob Gunderson W2JIO was with his Braille Technical Press for many years. And there was Stan W2ET, another old-time blind ham. Bob Weitbrecht W6NRM was stone deaf, so he helped pioneer radioteletype.

I guess it comes down to how insecure we feel. People who feel inferior make up for it by putting others down. It's called the redneck syndrome, not one of the more endearing American qualities. Indeed, we Americans are rather well known for this. We're known as Ugly Americans in many countries for our surplus of the smug, boorish, and arrogant. Yet here we hams are, speaking over the radio every day as supposed goodwill ambassadors for our country.

Y'no, if we don't clean up our act, we're going to have an awful job getting two million new hams into our ranks. Our overly-ugly contingent will drive 'em away as fast as you get 'em interested in checking out the hobby. And you know who they are. You hear 'em on the repeaters with bad language, bad-mouthing this or that. I've a new flash for you: It's your responsibility to see that hamming is fun. Fun on the air. Fun at club meetings.

That's not the responsibility of an ARRL director, or your club president—it's your job.

Making Ham Radio Fun

What's the most fun you've had in ham radio? When are you going to sit down and write me a letter and tell me what you've found the most fun—what's been the most exciting for you?

I suspect that if we can get newcomers to work DX on 10 meters, they'll have fun. Now, they can do that with a super bandbanger rig, kilowatt amplifier, and six-element full-sized beam on a 100-foot tower. They can also have a ball with a converted CB rig on 10 meters and a dipole. There they'll have the added excitement of converting the rig—getting into the guts of it with a soldering iron.

They're not going to do this unless you do it first and write articles telling 'em how. With CB rigs going so cheap these days, what's stopping you? And you don't need a beam to work out on 10 meters—a simple twinlead dipole does wonders. How long does it take to throw a string up into a tree with a weight on it and hoist a dipole between a tree and your house? Minutes.

You say you believe in CW? Okay, how about putting your word processor where your mouth is? First let's see what you can do to cook up a simple solid-state CW rig—maybe one Watt. Then get on the air and work some stuff. Now write a construction article so a few hundred others can join you. Back before Incentive Licensing in the mid-60s, I was publishing small magazines for VHF (*6-Up*, Jim Kyle, Editor), contesting (*5-7-9*), television (*ATV*), and one for ham club newsletter editors (Marvin Lipton, Editor). Incentive Licensing not only almost destroyed the ham industry, it killed these specialized magazines.

If we are able to get some school radio clubs going we're going to need simple projects like QRP rigs to get the kids excited. I'll find some ham companies to make parts kits available—even the printed circuit boards—so you won't have to pull a strain.

If you'll get some QRP rigs going, I'll see what we can do about setting aside a few kHz for QRPers so they won't get clobbered by the ten gallon heads.

Has your club started with hidden transmitter hunts yet? What do you need? Let's start seeing fox hunts on 2 meters, on 10 meters—hey, why not on 220, the band shouldn't be totally dead?

Then I want to see some articles (with pictures) on your club activities. I want articles on how to build simple transmitters for hunts—hand-held receivers, antennas, the works. Wouldn't it be nice if in a couple of years we had a national fox hunting team we could send to Europe for the international finals?

Getting a ham ticket, buying a rig, and getting on the air to rag-chew doesn't do a young ham a lot of good. It doesn't do our hobby much good, either. Only if we get our newcomers excited about the hobby so they're induced to learn by the fun they're having, will we be worth anything to them.

Thirty years ago when I published theory articles I got good solid feedback from the readers. They wanted more. Today I find that theory articles are virtually invisible. What's happened to the sense of excitement and pleasure in learning? Did that go the way of our educational system, turned into bland pap?

A little quiz. How much do you really know about radio? How long has it been since you made a serious effort to learn more? Could you get up in front of a club and explain how RTTY works? How about packet radio? I'll bet a school radio club would make mincemeat out of you.

What do you know about transistors, ICs, gates? If you wanted to build a rig for 10 GHz, how would you go about it? On what frequencies are the 10 meter FMers working? Have you ever worked 2 meter aurora? How about OSCAR? When are you going to get active on OSCAR? We've had ham satellite communications available for you for years now—what's it going to take to get you off your duff and busy at the workbench? We're not talking big bucks here, just how much of a ham you really are!

If I were able to find someone to write a simplified technical series for *73*, would you even bother to read it? This is supposed to be a technical hobby, unfortunately for about 99% of us, and I may be being kind even at that, it's just an operating hobby, with us showing little interest in the technical side.

If you're an engineer, why should you bother with ICs? Modern rigs are too complicated to fix, so what's the use? It takes thousands of dollars in test equipment and a Master's degree to fix a synthesized transceiver, right? Well, perhaps, either that or a motivated youngster with a VOM.

If I could get some articles for you on how to fix your ham gear, would you read'em? Sigh, I was afraid not. Well, if I can't get you off the couch and away from your TV to learn more technically, how about getting you busy with your local ham club? How about you as a spark plug to get your club into putting on hidden transmitter hunts on weekends? How about Novice classes? Providing communications for local events, such as sports car rallies, walkathons, marathons, helping local TV stations with fund raisers, putting on ham demos at shopping malls and in schools. How about club picnics, flea markets, auctions? Eat prunes and get things moving.

"Ignorance, like alcoholism and drug dependency, tends to protect itself."

Your Ham Activity Score

Have you ever worked:

__ SSTV?
__ RTTY?
__ AMTOR?
__ High speed CW?
__ FAX?
__ 100 countries?
__ 200 countries?
__ 300 countries?
__ 50 countries on 75/80m?
__ 50 MHz?
__ Putting up your own repeater?
__ 220 MHz?
__ 450 MHz?
__ 900 MHz?
__ 1.2 GHz?
__ 2.3 GHz?
__ 3.3 GHz?
__ 10 GHz?
__ Via Packet?
__ Via OSCAR?
__ VHF contests?
__ DX contests?
__ Sweepstakes contests?
__ From a rare country?
__ As a QSL manager?
__ As an officer in your local radio club?
__ As an Elmer?
__ To put on a hidden transmitter hunt?
__ To provide communications for a civic event?
__ To demonstrate ham radio publicly?
__ To build a Heathkit?
__ From a mountaintop on VHF?
__ To provide real emergency communications?
__ At giving talks about ham radio to local civic groups?
__ At talking up ham radio over local radio or TV stations?
__ Aurora DX?
__ Moonbounce?
__ 50 MHz DX?
__ On your club newsletter?
__ To write an article for a ham magazine?
__ To provide PR for your local club?
__ QRP?
__ To build a QRP rig?
__ With your club for Field Day?
__ All states in one weekend?
__ 100 countries in one weekend?
__ All continents in one hour?
__ To run a service net?
__ Over 100 Novices since getting your higher class ticket?
__ To keep up with the technology?

You get two points each, so what's your total? Mine's 84, but then I wrote the quiz, so it could be slightly biased.

Oh yes, getting back to the gay hams, if you were in my spot, would you overrule the wiser and more conservative heads at *73* and run their classified ad? And if we open the gates to special groups, will we next be asked to run ads for other groups looking to organize such as Mensans, Irish, Polish, Lithuanians, Latvians, Estonians, Scots, Brits, Hispanics, Blacks, Catholics, Protestants, Methodists, Shiites, Hedonists, Bon Vivants, Episcopalians, Congos, Commies, Demmies, Socialists, Capitalist Pigs, Nazis, Lutherans, Mormons, Scientologists, Moonies, Lions, Kiwanians, Nerds, AMers, Scatologists, Philatelists, Numismatists, Herbologists, Philologists, UFOlogists, Occultists, Satanists, Feminists, Ecologists, Conservationists, ex-submariners, ex-cops, ex-CIA agents, ex-FBI agents, ex-Secret Service agents, ex-Mafia, XIRS agents, XT-Men...hey, this could be a major source of classified income!

I don't know if we have enough frequencies for every group to have a net. They may have to time-share. And what do we do about conflicts where a lesbian Nazi feminist wants to meet all three groups at the same time on different frequencies? Hey, don't shoot the messenger? I just want to get everyone sorted out so they can have the most fun.

By the way, I put no stock whatever in the old saw that the left-leaning of America is responsible for the fruits and nuts settling in California. Since a ham ticket is the closest thing we have to a registration card certifying us as nuts, we're not in a position to throw stones.

Psychic Communications

A recent scientific study of identical twins separated at birth and raised separately astounded the scientists, bolstering the hereditary behavior school and discouraging the environmental school.

Each time we see the results of these scientific studies we're faced with trying to explain how twins who have never met each other manage to have wives with the same names, second wives with the same names, children with the same names, dogs with the same names, smoke the same brand of cigarette, and dozens of other coincidences which are far beyond the laws of chance.

The hereditary school says ha, it's genetic. You see, a fantastic amount of our behavior is controlled by our genes. The environmental school mopes.

My own take on this is that neither should put much stock in the results of these studies. I'll bet they'll find that identical twins have a higher than average ability to psychically communicate. Don't snicker and say, "There goes Wayne again." You can put me down if it makes you feel superior, but if you ever get a chance to talk with me personally—or have the guts to write and snicker in writing—you'll find that I have done my homework.

In this case we're talking a few dozen books, who knows how many magazine articles, many scientific conferences, and so on. Perhaps you recall the early work of Dr. Rhine at Duke

University. One of his scientists was a close friend of mine—I participated in many early experiments on psi and have kept up with the research it the field ever since—some fifty years now.

Psychic communication is very well-documented. Scientists have a serious problem with it in that no repeatable experiments have yet been devised—therefore they can't accept it as real. How do you scientifically measure something which just happens now and then—seemingly at random?

My own experience, which I've probably written about before, was several years back. I was in the middle of a most upsetting emotional experience when the phone rang. It was my mother. She said she sensed something was terribly wrong. She sure was right. This was the only time in my life she ever called like that—and her call came at the very peak of my anxiety—over something she had no way of knowing about. Coincidence? Baloney!

So if my mother could sense my anxiety, how much more in communication, on whatever level this is, may identical twins be? The next question is, how can we study this mechanism and perhaps develop it? Will we someday be able to sit back in a chair, relax, and call CQ with our mind?

In the meanwhile, let's be skeptical of the scientists who attach too much importance to heredity. I do believe time will show that IQ and many personality traits are genetic, but that these are modifiable to a great degree by the environment. Having a high IQ is very much like having a higher capacity computer available than others. The operation of the system still depends much on the programming and the data acquired. Lousy programming will screw up both the computer and the data. Bad data or a lack of data will keep even the best computer from being effective.

Ignorance, like alcoholism and drug dependency, tends to protect itself. The alcoholic refuses to accept the problem. Ditto the drug addict. Ditto the ignorant. Yet none of these conditions are curable until the person is able to admit to himself there really is a problem.

It's odd about scientists. There's no stigma attached to research in the hard sciences—and we've seen constant progress: the Big Bang concept, the isolation of the strong and weak nuclear forces, the new short-range gravity force, recombined DNA, plate tectonics, ovonics, ever smaller microchips—yet we've seen dismayingly little progress in psychology, psi phenomena, understanding death, and other such soft sciences.

Education might be called a soft science. While there have been many experiments in education, there is little in the way of research, so there's no way to develop the science of education. I'd like to see a university take on the challenge of improving education. They could do this by seeking out and investigating experimental educational systems. The ones with promise should be tested further, with the results made generally available.

The one thing that might help education more than anything else would be a magazine dedicated to the science of education. This would act as a networking communications medium for those interested. It would also help newcomers to the field come up to speed on the state of the art. Thirdly, it would provide a marketing medium for entrepreneurs to start businesses offering educational systems—hardware, software, and information products. Indeed, it is almost impossible to get a new field to grow without a dedicated publication.

Nova recently did a marvelous program on the advances in Ovonics—particularly showing the new ovonic solar cell system. The inventor, Ovshinski, has been frustrated trying for years to get his inventions accepted. Obviously no one has explained to him the critical importance of publishing. If there were a dedicated publication for this new field of amorphous crystals, I believe it would quickly take off and soon be accepted.

If I'm taking your mind off more important things like Monday Night Football or holding you from getting out there for golf, apologies—I just thought you might be interested—or need something to grouse about on the air.

Well, what do you think?

Good Works

A letter from a ham in Florida who's retired and trying to live on Social Security, has serious medical problems and an equally sick wife, said he didn't have enough money to subscribe to *73*. Worse, his rig broke and he doesn't have enough money to fix it, so he was hoping maybe I could find a ham to donate a rig to him so he could get back on the air.

Judging from the average age of the ham population and the relatively low income of the average ham before retirement, there must be thousands of hams who are in similar desperate straits. I think something should be done to help these old-timers get back on the air, don't you?

One of the worst aspects of old age is the loss of friends—the loneliness. Many kids don't want to be bothered with their old parents, so it's often a terribly lonely life. Many old people can no longer see well enough to drive, so they're isolated. Ham radio is a wonderful way for these old-timers to keep in touch—to have friends.

We had one such chap who spent his declining years on the Derry (NH) .85 repeater. He was on there ten to twelve hours a day since he didn't have anything else to do. He had enormous medical problems which he shared with us 85ers. I think we all enjoyed this lonely little cantankerous old man.

There's a need, I think, for a retired ham or even a ham club to form a nonprofit Old-Timer Ham Assistance League with the purpose of finding old ham gear, making sure it's repaired and working, and getting it to unexpired hams who need it. Lord Knows we need the activity on our bands.

Tens of thousands of us have old ham gear lying around unused. So why not put it to some really good use? And, if we can get a nonprofit organization going, we'd even be able to get a tax credit for our donation! That might even do better for us than foisting it off on someone at a flea market, swap meet, or ham auction.

I'll be surprised if there aren't some groups already doing this, but doing it without a lot of fanfare. Even so, we could use more—perhaps groups in our major retirement areas where they could not only help the old hams get the gear they need to get on the air, but would be able to help them repair it when they mistune a final and blow the tubes. We'd want groups in Southern California, Arizona, Texas, and Florida, at a minimum.

Wouldn't it be wonderful if we could use this reservoir of ham experience to help hold some of our endangered bands? The lack of activity on 50, 220, 1200, 2300, and 3300 MHz could easily lose them for us in the near future. Have you any ideas on how we could get equipment built for these bands and into the hands of retired hams who have little else to do?

Bill Hoisington K1CLL, when he was in his 70s, designed many extremely simple and inexpensive-to-make rigs for these bands. If you have some old issues of *73* you can look 'em up. He showed how to make gear for the microwave bands on the kitchen table using very low cost parts.

So what do you think? Can your ham club look around for some impecunious old-timers or otherwise handicapped hams to help get on the air? They need rigs, antennas, and encouragement.

USO Satellites continued from page 64

nel sharing and message forwarding will be tested. The satellite subband on 2 meters is already getting crowded, and the six new OSCARS will add to this congestion.

Using the UoSAT-D PCE, we will try to find efficient ways to use a single 2 meter uplink channel, rather than using several uplinks like Fuji-OSCAR-12 and the Microsats. More information on the proposed experiments can be found in "The UoSAT-D Packet Communications Experiment," by J.W. Ward, in the *Proceedings of the ARRL 7th Amateur Radio Computer Networking Conference*, Oct. 1, 1988, Columbia, MD.

A satellite requiring a new modem and special protocol software might not sound like a good deal to the cost-conscious amateur, but UoSAT-D has its advantages in the RF area.

A multi-power transmitter will provide selectable downlinks of 1, 2.5, and 10 Watts. The medium- and high-power downlinks will reach stations with simple, non-steered antennas: crossed dipoles or even vertical whips. The uplink requirements will also be simple: 10 or 20 Watts into an omnidirectional antenna will allow messages to be stored on UoSAT-D. Of course, stations tracking OSCAR antennas will have better links, but at 9600 bits/second, it takes less than a minute to transmit a message as long as this article! Amateur radio stations with simple RF systems and advanced packet radio equipment are becoming more common, and their operators will be attracted to the PCE.

Experiments on UoSAT-D and UoSAT-E

The PCE will interest packet radio enthusiasts, but what do we have in mind for the experimenters and educators who have grown to expect scientific and engineering data from UoSATs? UoSAT-D will be devoted primarily to the PCE, but it will also carry a Cosmic Particle and Total Dose Experiment (CP/TDE) designed to measure the effects of radiation on semiconductor devices.

The CP/TDE will, for the first time, provide us with calibrated measurements of the total radiation dose received by an OSCAR satellite in polar orbit. UoSAT-E will be dedicated to experiments. A parallel-processing array built from 3 transputer microcomputers will provide data compression and image enhancement for a newly-designed CCD camera. The on-board computer will monitor the efficiency of experimental solar cells made from several new materials, and protected by different cover glasses. Low-cost sun sensors and Earth-horizon sensors designed by researchers at the University of Surrey will be used in a simple, high-precision attitude control system. Of course, data from these experiments will be available on the UHF downlinks.

The launch of the Ariane 4 rocket carrying SPOT-2, UoSAT-D, UoSAT-E and Microsats-A through -D is scheduled for later this summer. For up-to-date news of developments at UoSAT (and throughout the AMSAT community), monitor the plain-text bulletins on UoSAT-2. If you aren't yet equipped to copy the satellite, AMSAT information nets, newsletters, and packet radio BBSs are all good sources of information.

I hope that this article has encouraged you to try your hand at satellite experimentation in the Amateur Satellite Service. If you want to see firsthand what is happening at UoSAT, and hear presentations from international AMSAT builders and operators, come to the 4th annual AMSAT-UK Satellite Colloquium, which will be held July 28–30th at the University of Surrey. If you're an adventurous engineering student, consider a course in Satellites and Telecommunications at UoS. The team building UoSAT-D and -E in England includes Zeno Wahl VE3LMX, Jeff Ward K8KA, and Michael Meerman PA3BHF, who were attracted to Surrey by the lure of building OSCARs while learning!

Ampire 146-OS continued from page 67

factory claims that the unit will operate over a temperature range of −30 to +130 degrees F. Our temperature chamber test indicated operation to −45 degrees F, with an improved noise figure of 0.65 dB at this temperature!

Lastly, we did a two-tone, third order intercept point measurement test. This parameter shows the ability of a device to stay linear and not act as a mixer generating undesirable signals when two strong, in-band signals are applied simultaneously to its input. We plotted the intercept point at +26 dBm, with the tones spaced at 100 kHz. The −1 dB compression point occurred at +3 dBm.

Design and Execution

A quick analysis of the Ampire 146-OS showed a dual gate GaAsFET transistor amplifier, biased in Class A design for best noise figure and linearity performance. A high quality passive postselector filter is an integral part of the unit, and follows the GaAsFET amplifier. This arrangement maintains the best possible noise figure in the amplifier. (Note: A passive preselection filter's loss, placed in front of the amplifier, would add directly in dB to the receiver noise figure.) The idea is to have particularly good dynamic range, while maintaining the lowest noise figure, in order to handle undesirable signals before they can cause odd-order intermodulation products to fall within the receiver passband. The filter reduces the out-of-band undesirable signals, and the net effect is to improve the third-order intercept point of the following receiver stages. The gain of the amplifier improves on wanted, in-band signals which are further applied to the receiver.

The tests described above indicate a relatively good trade-off between the noise figure and the intermodulation performance of the 146-OS product. On-board silicon diodes help to protect the preamplifier's input. (Another choice would have been to use an internally protected GaAsFET which would also use diodes.) During the tests we didn't note any evidence of intermodulation distortion caused by the diodes.

Standard microstrip techniques on G-10 fiberglass material, using tuned quarter-wave miniature coaxial transmission lines, implement the entire circuit. This optimizes the noise figure, saves circuit board space, reduces electrical loss, and improves overall stability. Throughout the unit there are chip capacitors for decoupling.

The DC sensory circuitry is typical of this type of unit. The 146-OS is different because it uses commercial grade metal transistors instead of the more commonly found plastic equivalents. Unlike other units, the Ampire 146-OS features onboard DC regulation. Power requirements are 13 to 20 Volts at 105 milliamps. Mechanically, the unit shows a clean layout. The PC board is sprayed with a low dielectric clear compound which protects it against humidity. The unit is housed in a sealed iridited aluminum box ready for mast installation. In addition, the preamplifier comes equipped with good quality N-type connectors for reliability.

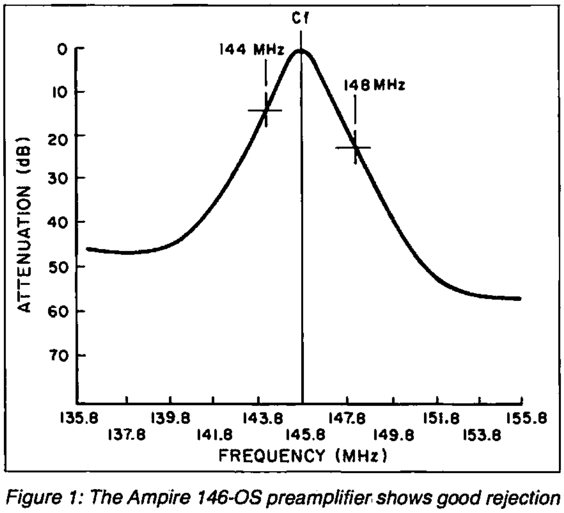


Figure 1: The Ampire 146-OS preamplifier shows good rejection of out-of-band signals.

Conclusion

We tested and analyzed the Ampire 146-OS preamplifier against the manufacturer's specifications. It is our conclusion that it presents a good value for the money in applications where a quality product is required.

PROPAGATION

by Jim Gray W1XU

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An Overview of May

Generally, May will be a quiet month with very few really poor days for propagation on the HF bands. You can expect some good 2 and 6 meter openings this month as well.

May 12, 13, and 14 will be generally poor, as will the period between May 23 to May 27, and possibly until the 28th or 29th. The rest of the month will be Fair to Good, with propagation on the HF bands generally available on a worldwide basis from dawn until after dark, depending on the band you choose.

DX Opportunities

Ten and 15 meters will be jumping with DX opportunities, and 12 meters as well, although 12 has not been as highly populated as the other two. The new 17 meter band will be excellent from early morning until well after dark, with both transcontinental USA propagation and transoceanic propagation. Just pick your time and where you'd like to be heard.

As always, 20 meters will be the good old bread-and-butter band for DXers, with 17 meters becoming a close second, even though it has much less available bandwidth.

In case you don't know or can't remember, here are the WARC bands: 12 meters—24.890–24.930 MHz; CW—24.930–24.990 SSB; 17 meters—18.068–18.110 MHz; CW—18.110–18.168 MHz SSB; 30 meters—10.100–10.150 MHz CW (no SSB). I have not gone into other modes or power limitations here (and these vary from band to band). The WARC bands are getting a workout, and I think you'll find them all useful and fun. But don't neglect the old standbys!

Stay Informed

The WWV forecasts and current solar-terrestrial indices are, as always, available at 18 minutes past each hour on 10 MHz and 15 MHz and 5 MHz (AM). You will hear current solar flux values (the higher, the better); A index values (the lower, the better); and trends from the past 24 hours through the present, to the next 24 hours. Good hunting, and enjoy it while it's hot! 73

MAY

SUN	MON	TUE	WED	THU	FRI	SAT
	1 G	2 G	3 G	4 G–F	5 F	6 F
7 F–P	8 P–F	9 F–G	10 G–F	11 F–P	12 P	13 P
14 P–F	15 F–G	16 F–G	17 G	18 G	19 G	20 G
21 G–F	22 G–F	23 F–P	24 P	25 P–F	26 F	27 F–P
28 P	29 P–F	30 F	31 G			

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20	-	-	-	-	-	20	-	-	-	-
ARGENTINA	15	20	20	20	40	-	-	-	15	10	10	10
AUSTRALIA	15	20	20	20	20	-	40	20	-	-	-	15
CANAL ZONE	20	20	20	20	40	-	-	15	15	10	10	10
ENGLAND	-	40	80	40	-	-	20	15	15	10	15	20
HAWAII	15	15	20	20	40	40	40	20	20	-	-	10
INDIA	-	-	-	-	-	-	-	-	-	-	-	-
JAPAN	15	20	-	-	-	-	-	20	-	-	-	-
MEXICO	20	20	20	20	40	-	-	15	15	10	10	10
PHILIPPINES	-	-	-	-	-	-	-	20	-	-	-	-
PUERTO RICO	20	20	20	20	40	-	-	15	15	10	10	10
SOUTH AFRICA	20	-	40	-	-	-	-	-	-	10	15	20
U.S.S.R	-	40	-	-	-	-	-	20	15	20	-	-
WEST COAST	15	20	20	40/80	80	-	-	-	-	15	10	10

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20	20	20	-	-	40	20/40	20	-	-	-
ARGENTINA	15	15	20	20	40	40	-	-	-	-	10	10
AUSTRALIA	15	15	20	20	20	-	40/80	40/80	-	-	15	15
CANAL ZONE	10	10	20	40	40	40	-	15	15	10	10	10
ENGLAND	40	40	-	-	-	-	-	20	15	15	15	20
HAWAII	10	15	20	20	40	40	-	20	20	15/20	15	10
INDIA	-	-	-	-	-	-	20	20	-	-	-	-
JAPAN	15	20	20	20	-	-	40	20/40	20	-	-	-
MEXICO	10	10	20	40	40	40	-	15	15	10	10	10
PHILIPPINES	15	15/20	-	-	-	-	-	20	20	-	-	-
PUERTO RICO	10	10	20	40	40	40	-	15	15	10	10	10
SOUTH AFRICA	20	20	-	-	-	-	-	-	15	15	15	15
U.S.S.R.	-	-	-	-	-	-	-	20	15	15	20	-

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15	20	20	20	20	40	40	-	-	-	15
ARGENTINA	15	20	20	40	-	-	-	-	-	-	10	10
AUSTRALIA	10	15	20	20	20	-	40	-	20	20	-	15
CANAL ZONE	20	20	20	40	40	-	-	-	15/20	15	10	10
ENGLAND	-	-	-	-	-	-	-	-	20	20*	20*	20
HAWAII	10	15	15	40	40	40	40	40	-	20	20	20
INDIA	-	15	15/20	-	-	-	-	-	20	-	-	-
JAPAN	10	15	15	20	20	20	40	40	-	-	15	15
MEXICO	20	20	20	40	40	-	-	-	15/20	15	10	10
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PUERTO RICO	20	20	20	40	40	-	-	-	15/20	15	10	10
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EAST COAST	15	20	20	40/80	80	-	-	-	-	15	10	10

73 AMATEUR RADIO®

JUNE 1989
ISSUE #345
USA $2.95
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International Edition

A WGE Publication

QRP Home-Brew!

Three great rigs for 80-20 meters!

6m low-power fun

Simple SWR bridge

Reviews:

Micro H.T wonder

Low-cost 100W 10m action

Butane soldering iron!

Tune to a "T"

Plus:

Net/ROM vs. TheNet
—case of software piracy?

A look at Spread Spectrum

More on hamsat telemetry

220 MHz transverter PA

Welcome, Newcomers!

WHAT IS QRP?

Amateur radio lingo is full of abbreviations and code words, which evolved in the days of CW (Morse Code)-only communications. Many common statements and questions, such as "Do you copy?", "My location is...", "Please send more slowly", etc., have been reduced to three-letter statements/questions beginning with "Q." This gave CW communications—a much slower mode than spoken ("voice") communications—greater efficiency.

QRP means "reduce your power." Hams who enjoy low-power operation became known as QRPers. The unofficial maximum power level for QRP operation is 10 Watts. One Watt or less of transmitted power is called QRP operation.

At first, many hams ask, "What's the point in QRP operation?" Mayhem often reigns on the bands during periods of good **propagation**, with some hams running a **full gallon**-plus battling it out. "How can the **little gun** hope to compete?" "Why would anyone *want* to be a little gun?"

To be sure, there are reluctant QRPers—hams who make do with the equipment they have until they save up enough to run out and buy a 100 Watt output **rig** and/or a **linear amp**. QRP has a large devoted following, however. There's obviously much more to QRP than first meets the ear, as this issue will attempt to show.

The Elegance of QRP

A QRP station can be very small—there are QRP transceivers that can fit in the palm of your hand! QRP rigs are much simpler devices than their high-powered brothers, since there are fewer stages of circuitry in the rig to step up the power of the signal and ensure signal **linearity** and **purity**. One- or two-afternoon QRP transceiver projects abound—Mike Bryce's QRP column is full of 'em. For hams who actually want to *apply* the electronic theory they learned (or memorized) for their exam, building a QRP rig is a great place to start—very little can match the thrill of making a **DX** contact on a piece of equipment that you've built yourself!

Craft Instead of Kilowatts

Let's say you've built your pocket-sized 5 Watt rig on Friday night and Saturday, and hanker to get on the air on Sunday. You know, however, that when propagation is good, the bands are often wall-to-wall booming signals. What to do?

QRPers have to be a tenacious breed, but they soon learn that power is not the only factor in making a contact. They bag many of their contacts when a particular band just opens up, before most other hams become aware of it. This doesn't mean that QRPers sit by their rigs 24 hours a day—many band openings are predictable. A QRPer soon becomes skilled in the science of propagation.

The science is far from exact. There are unpredictable bands. Ten meters is often closed, especially during low sunspot activity, but it can **open up** very suddenly at different times of the day. This band needs more monitoring, but then the chances are better that fewer people will become aware of its opening, and the QRPer has a longer opportunity to work DX. When propagation is good, your signal can be *milliwatts* and still get a good report from a DX station.

A Little Antenna Math

A QRPer's best edge is a high-gain antenna system. Improvements here pay dividends at *both* ends of the path—receiving ("hearing") and transmitting ("talking").

What does gain mean? Gain is simply a *ratio*, usually expressed in decibels (dB). When you talk about an antenna having a certain gain, you must specify gain *over a reference antenna*. Logically, gain relates not only to the **effective radiated powers (ERPs)** of a pair of antenna systems, but also to the received signal gains of the same system pair.

An antenna's ERP increases logarithmically with its gain. Here's a handy rule of thumb: every 3 dB gain increase doubles the ERP. For example, a 3 dB antenna has twice the ERP over a given reference; a 6 dB antenna has four times the ERP over that reference. A 9 dB antenna?—eight times the ERP!

What's a good reference antenna? One of the most common ham antennas is the ½-wave dipole. To note it as the reference, we tack a "d" on the end of "dB."

Ten dBd gain is a reasonable figure for a typical directional beam antenna that you can buy for a few hundred dollars, or build for less. By the above logarithmic scale, you can intuit that 10 dB is about 10 times the ERP gain. This means that the operator feeding 10 Watts into a 10 dBd beam has the same chances of making himself heard to that DX station as the op putting 100 Watts into his dipole!

Can 10 Watts into a 10 dBd gain antenna really compete with the rest of hamdom? You bet! Most hams live in areas that restrict antenna systems. A city lot may not provide room for more than a dipole or a vertical antenna. (A vertical has similar gain to a dipole). Most hams don't run more than 100 Watts into an antenna system since that is the typical limit for an unassisted transceiver, and linear amps are too pricey.

Clearly, a QRPer with a good antenna system is really in the running!

Hats Off to QRPers

The finest point of QRP operation is that it forces the ham to *think*. He has to experiment with his equipment—installing narrow filters, improving the gain of his antenna system, etc.—and learn about propagation. The QRPer avoids the all-too-easy solution of cranking up the power to get through the crowds, which very easily leads to crowding out others. He shows courtesy to his fellow hams by almost never running more power out than necessary to conduct a contact (which is, incidentally, an FCC rule!). This is what separates the QRPers, who practice two critical mandates of the hobby—advancing the state of the art and fraternal goodwill—from the emerging throng of appliance operators who treat the linear amp as a cure-all.

This issue has a host of simple QRP transceiver construction projects to get you active on most of the **HF** bands. Happy home-brewing, and let us hear from you!

...de NS1B

GLOSSARY

DX—Abbreviation for Long Distance. DX for the HF bands is typically transcontinental.

ERP—The power measure of the wave energy that radiates from an antenna that is the product of the input power into the antenna system and the net gain of the antenna system.

Full-gallon—Ham jargon for a kilowatt of output power.

HF—High Frequency. Refers to the 80–10 meter (3–30 MHz) bands. 160 meters (1.8–2.0 MHz) is US Amateur Radio's only Medium Frequency (MF) band.

Linear Amp—Short for linear amplifier. This device takes an input signal and increases its power without (ideally) changing any of its other characteristics.

Linearity—An expression of the resemblance between the input and output signals of a circuit. The better the linearity of a circuit, the less it distorts a signal.

Open up—Ham jargon meaning "provide good propagation."

Propagation—The transfer of energy (in this case, electromagnetic energy) through a medium, such as the atmosphere or space.

Purity—Most often an expression relating the power of the fundamental frequency of a signal and the power of its non-fundamental frequencies, such as harmonics. The purer a signal, the more pronounced its fundamental relative to its non-fundamentals.

Rig—Ham jargon for transceiver.

Transceiver—A radio set that contains a receiver and a transmitter in the same chassis.

QRM

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Contract:
The mere reading of this contract between you and *73 Magazine* is acceptable evidence of your total and unequivocable agreement to its terms. If you want out now, too bad. You have hereby agreed to the following, to do everything in your power to get the ARRL to push the FCC for a no-code license, to get your local ham club to sponsor school radio clubs in all area schools, to stop smoking, to embark on a serious diet so that you won't contribute to the burgeoning list of Silent Keys, to turn in your parents if they are using illegal drugs, to make sure Wayne Green's talks at hamfests are packed, to build at least four home-brew projects per year, to use the Reader Feedback cards to vote on the articles, to send in the Reader Service card every month, and to buy at least three products advertised in *73* each year.

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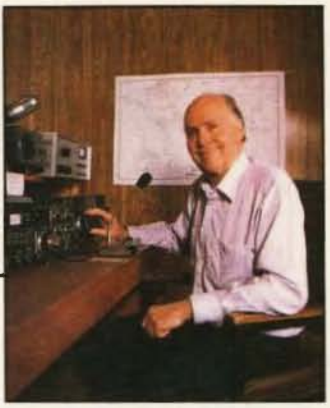
FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

Cover by Marilyn Moran; Cover photo by John Shotwell: Bruce NZ5G and Bill N5HNN show you how to build a rig to work the world.

Number 2 on your Feedback card



NEVER SAY DIE

Wayne Green W2NSD/1

Oh Darn, My Kid's Gone Bad

If you read much, you've been reading about the sorry state of American education. There's less being written about why our educational system isn't working, but since it's going to be difficult to fix it if we don't know why it's broken, perhaps we need to not just be aware of the problem, but to also find out what went wrong.

We know that amateur radio is broken, too. We also know when it broke and why, but we don't know how to fix it because we find ourselves running into some of the same problems as we do in education.

Amateur radio went along pretty well from 1946 until 1963, growing at 11% per year for this 17-year period. Then, suddenly, it died. We're not talking about a gradual drop, we're talking a cataclysm–a drop in ham sales of 85% in one year! A drop from an 11% growth to a 5% loss in one year! We're talking a loss of 85% of our ham dealers and most of our manufacturers within a few months!

While the "Incentive Licensing" proposal by the ARRL nuked the hobby, there were several other factors which tended to exacerbate the situation. They couldn't have picked a worse time in history to pull what the ARRL directors considered was primarily a publicity stunt to focus attention on the League.

Here we were, in the depths of a sun spot low, so the bands were in terrible shape. Hamming was at its worst as far as operator frustrations were concerned. This, in itself, would tend to exaggerate any negatives. Ten was dead as a doornail. Twenty was closed at night, and stinky even during the best of days. Eighty was awful, with the normal local area contacts sometimes almost impossible. It just wouldn't take much to get a lot of hams to chuck it all in and sell their rigs at a frustrating time like this.

In addition to that, we had the FCC starting to charge us for our licenses. It wasn't much, nowhere near what we were costing them, but many hams were able to blow this all out of proportion. Eventually the FCC got stopped by the courts and had to give back much of the money. But in the meantime, it was one more large straw on our backs. One more frustration.

There's more. These were the '60s, complete with rebelling youngsters—the combined products of several major changes in our whole basic culture. There was the incredible influence of Dr. Spock, with his "let your kid do his own thing" approach to child non-training. There also was the impact of the two-worker family, where the mother was no longer at home to bring up the children.

There's more. Added to Dr. Spock and the working mother, we also had the pernicious influence of TV—not just on the kids, but also on the whole family. This was the first generation of kids which grew up with the TV set on all day every day at home. TV was the baby sitter, and then the chewing gum of the mind. It kept the kids from doing their homework. No problem, get the schools to stop bothering us with homework.

So into this powder keg the League dropped the Incentive Licensing bomb. It turned what was already a precarious situation into a disaster from which we have never recovered. Within a couple of years we lost not only our ham dealers and manufacturers, but we also lost a large percentage of our old-time ham clubs, and almost all of our school radio clubs.

The school clubs were the worst loss of all because that wiped out the infrastructure which had been bringing us 80% of our new hams. By 1970, when the sun spots were peaking again, we were able to get back to a small growth. The enormous interest in FM and repeaters, plus a supply of frustrated CBers, also contributed to this slight growth.

So what's happened to amateur radio, other than the Incentive Licensing catastrophe, has been symptomatic of the problems America has had with its kids and with education.

Let's look at this another way to understand it better. If you buy a dog and bring it into your home to live with you, unless you take some time to train that dog, you're going to have a pest who is chewing your slippers, barking at night, jumping on people, begging for food at the table and so on.

Dogs eagerly take to training. It doesn't even take very long, if you bother to learn how to do it. They are happier and more comfortable when they are trained. They need to understand what's expected of them and to know that they're loved. Dogs will do almost anything for love. But if you use punishment to try and train them, you're not going to have a happy dog, nor a trained one.

Isn't it odd how parallel the training of kids is to training dogs? You get out of a dog what you put in. If you put in some time and love you'll get a happy, well-behaved dog who will give love right back. If you put love into a kid you'll get the same. Is that a news flash?

So how do most people train their kids? With gripes about their failures (punishment), with nagging, and with withholding love. Isn't it absolutely amazing how badly this has worked out?

Well, providing you, unlike your kids,

continued on p. 90

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock, NH 03449, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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QRX . . .

Apprentice Class?

The push for a no-code licence is gathering more steam. Citing their support from AMSAT, TAPR, and Goldwater, the South Coast Amateur Technical Group, a Melbourne, Florida ARC, filed with the FCC for the creation of a code-free entry-level amateur license. The "Apprentice Class" ticket would replace the current Novice license. Apprentice licensees would have access to all modes and bands above 30 MHz and a full 1500 Watts maximum power output, but the license is good for only one 10-year, non-renewable term.

Space Coast suggests the same testing procedure as for the current Novice class—two examiners with General Class or higher licenses unrelated to the examinee, over the age of eighteen, and not commercially involved in amateur radio. The proposal impacts only on the current Novices, who would be granted Technician privileges for their license terms at the time the Apprentice Class was created.

Expect more such proposals to cross the FCC's plate in the near future. A recent survey by *CQ Magazine,* to which nearly 4500 people have responded so far (especially unusual, considering that the respondents used their own postage), show the no-coders leading the pro-coders by a 60/40 margin.

Siddall

Congratulations to David Siddall K3ZJ, one of amateur radio's greatest supporters in Washington, DC. Dave has been named Assistant Chief of Law for the FCC's Mass Media Bureau, and as such, he will be responsible for the legal review of that bureau's major items. No stranger to the Washington scene, Dave served as Senior Attorney in the FCC's Policy Bureau. Prior to that, he was a Legislative Attorney with the Congressional Research Service of the Library of Congress. K3ZJ is the former president of both the Potomac Valley Radio Club and the Capitol Hill Amateur Radio Society.

73 BBS

73 Magazine BBS is back on line! You again have another way to submit material—opinions, ideas, and, of course, articles—electronically directly to us anytime. You may also download from our growing library of share-ware and public domain programs, and chat directly with the sysop online.

Some may recall last year the brief revival of the *73* BBS, cut short by a hard-disk crash, and the subsequent reallocation of our IBM PC-XT to the company's new Novell tokenring Local Area Network. Well, we're back and better than ever—the new system has a new 20MB hard disk and 60MB digital tape backup, assuring that no data will be lost.

As before, the *73* BBS uses the popular RBBS-PC program. It is a 24-hour/day service, and a sysop attends it for an hour each weekday. Give us a call at (603) 525-4438.

Good Work!

Congrats also to two outstanding members of the ham community. The Dayton Amateur Radio Association (DARA) named Bill Pasternak WA6ITF as 1989 Radio Amateur of the Year. Pasternak, founder of *Westlink Report,* has been the foremost supplier of amateur radio related news to hamdom.

The *Westlink Report* news series appears in hard copy every two weeks, and can be heard weekly on scores of repeater systems throughout the US. In addition, Pasternak founded and sponsored the "Young Ham of the Year Award," and was a leading producer of the award-winning 30-minute video "World of Amateur Radio."

Next, DARA has named Phil Karn KA9Q to receive the Specific Achievement Award. Karn has played a crucial role in the development of packet radio. Packet radio—on the amateur scene for less than 10 years—is a digital mode that has robust error-checking capabilities, channel sharing, and exceptional routing abilities.

Phil's forte in packet is software. He has been instrumental in developing and implementing TCP/IP, a protocol level that serves to interlink heterogeneous packet networks.

Solar Flare

The biggest solar flare in five years erupted March 7. A 43,000 mile-wide sunspot that began spewing X-rays, ultraviolet radiation, radio waves, and electrons "... was one of the most impressive I've heard of in my lifetime," said Patrick Mcintosh, project leader for solar physics research at NOAA's Space Environment Lab in Boulder, Colorado.

The huge radiation burst affected radio communications over a two-week period. During this time, many VHF and above operators made auroral skip contacts on weak signal (mainly CW), while many lower-band HF communications were wiped out. Two weeks is the normal time it takes for a sunspot to move across the face of the sun.

Solar flares can occur at any time, but they take place most often near or at the peak of the 11-year sunspot cycle. Scientists quoted by the New York Times say that the the most intense period of solar radiation on record likely lies ahead in the next year. The peak is expected to occur in January or February of 1990.

Though HF communications tend to be disrupted during flares, the general effect of increased sunspot activity is increased ionization of the ionosphere, which aids HF communications. NOW is the time to get active on these bands!

International Doings

Israel: The Israel Amateur Radio Club is taking on the challenge of bringing more youngsters into ham radio. They will adopt the Tel-Aviv Young Generation Repeater into the IARC Repeater Network. The IARC will also donate new hardware to expand the system range. The repeater currently runs only one Watt out, but that will be upped

$$ HOME-BREW IV $$

73 Magazine again invites all home-brewers to turn their hot solder into cold cash and prizes, and to get their name in print to boot. All projects have a chance to appear in the magazine, and we will handsomely reward the authors of the best of these.

Now for the bounty. Ramsey Electronics sweetened the pot from their line of frequency counters. First prize is $300, a 10-year subscription to *73,* and a CT-125 1.25 GHz frequency counter. Second prize is $150, a two-year sub, and a CT-90 600 MHz frequency counter. Third prize is $75, a two-year sub, and a CT-70 525 MHz frequency counter. All this is in addition to the payment every author receives for publishing in *73.*

Contest Rules

1. Entries must be received by 1 July 1989.
2. To enter, write an article describing your best home-brew construction project and submit it to *73*. If you've never written for *73,* send an SASE for a copy of our Writer's Guide, or download it from CompuServe (HamNet forum, Library 0., filename "73WRIT"). *Be sure to state on the submission that it is for the Home-brew IV contest.*
3. Here's the real challenge: The total cost of your project must be under $73, even if all the parts were bought new. Be sure to include a detailed parts list with prices and sources.
4. Our technical staff will evaluate each project on the basis of originality, usefulness, reproducibility, economy of design, and clarity of presentation. The decision of the judges is final.
5. All projects must be original. That is, they must not be published elsewhere. There is no limit to the number of projects you may enter.
6. If your article is accepted, *73 Magazine* will, upon publication, purchase first North American serial rights.
7. Mail your entries to: *73 Magazine*
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Attn: Home-Brew IV

QRX . . .

to something more substantial. 4Z4QZ will continue in his position as the repeater's Technical Custodian. This brings to nine the number of FM repeaters operating on two meters in this tiny Middle Eastern nation. The Young Generation Repeater operates on 145.375 MHz following the IARU Region I (European) Bandplan.

Japan: The Japan Amateur Radio League (JARL) is sponsoring two major operating events this year. Special Events station 8J1YES at the Yokohama Exotic Showcase is operating on 1.8 MHz–1.2 GHz through October 1, on all modes. 8J6APX will be on the air through September 3 on 3.5–50 MHz, operating CW/SSB/Packet in celebration of Fukuoka '89, the Asian-Pacific Exposition.

The crew of the St. Peter's (Missouri) ARC at their October '88 meeting. The evening's program was "How to Reduce Repeat TVI Complaints," given by WØOGS (the carrot). After a visit from this bunch, would you complain again?

Soviet Union: A new English-language amateur radio magazine is now available by direct subscription from the USSR. *Infotech Ham Magazine* contains such topics as Soviet DX News, Ham-to-Ham visits, technical topics, including VHF/UHF, news about happenings in Soviet radio clubs, and a ham equipment marketplace. Subscription brings with it automatic membership in the Infotech Amateur Radio Club International. Subscription is $36 US via airmail. Payment must be made to Acct. No. 61901005, VNESHBANK SSSR, Minsk Belbyttehnika. For further information write to *Infotech Magazine*, PO Box 41, Minsk, 220050, USSR.

Tornados

Alabama hams taking part in Emergency Net X-Ray won't soon forget the first weekend of March. As severe weather pounded the state, 170 hams spent over 30 hours handling priority messages. While the weather bureau issued scores of tornado warnings and amateurs assisted with emergency communications, two twisters struck a town just east of Birmingham. Amateurs remained on duty at the National Weather Service until Sunday evening. Good work!

Not Just Another Fish Tale

A recent issue of the journal *Nature* describes the work of scientists at the Scripps Oceanographic Institute in California on the electric fish *Eigenmannia*. These fish emit electrical discharges in the 300–500 Hz range from an organ on their tails, to detect friend and foe.

Imagine the mutual interference when two or more of these fish gather! Fortunately, these fish have developed a very sensitive jam-avoidance system. Using electrical detectors all along its body which compare signals from its own electric organ with those from nearby transmitters, the fish determines whether the jamming signal is at a higher or lower frequency than its own. When the fish figure this out, the one with the higher frequency rapidly moves up a few Hertz, and the one with the lower frequency moves down a few Hertz.

It's interesting to note that these electric fish automatically do as hams do—QSY off the QRM. Perhaps the ham equipment manufacturers or an enterprising home-brewer will take a cue from this curious creature!

Young Hams' Net

The North American Youth Net is a newly formed voice net for young amateurs to meet with hams of similar age. It meets on Saturday evenings, 2300 GMT (1900 EST) on 28.450 MHz. This allows young US hams of all license levels to check in. Ten meters has lately been open at that hour in the US.

Ham Prodigies

Sandi KC4AJO, meet Nathan KG5RC/AE. The March 1989 "QRX" column reported that Sandi was probably the youngest Extra Class licensee—she attained this highest level ticket at age 10 years, three months. Her record was edged, however, by Nathan T. Moore KG5RC/AE, ex: N5KSF, ex: KA5YCA, who turned 10 on October 7, 1988, and passed his Extra exam on New Year's Day 1989. Age when he became Extra Class: 10 years, 2 months, and 3 weeks.

Nathan passed his Novice when he was 6, his Tech at age 8, and his General at age 9. He passed his advanced on December 17, 1988, and his Extra only two weeks later.

Congratulations to these two exceptional members of our fraternity.

Next?

Uniden Mod Revisited

There are several updates and corrections to the Uniden HR-2510 modification article that appears on pages 34–35 of the April '89 issue. Radio Shack discontinued the DPDT DIP relay, part #275-213A—replace it with the Potter and Brumfield part #T85N11D114-12. The reference on page 35 concerning R39, a 2.2k resistor, is Photo A instead of Photo D. Finally, in the sentence following the last reference, change "R1/R2/C1" to "R1/R2/C2."

You may reach Uniden's Parts Department at 9900 West Pointe Dr., PO Box 50463, Indianapolis IN 46250. Tel: (317) 842-1036.

Need Manuals?

A good source of manuals for old equipment is Hi-Inc., PO Box 864, 1601 Ave. D, Council Bluffs, IA 51501. They carry manuals for most National, Hallicrafter, Hammarlund, and other rigs of similar vintage.

Errata

Please note the following items to correct:

February '89 issue, TS-940 review. The line,"250 Watts PEP output power" should read "250 Watts input power."

April '89 issue, "Aerial View." There are several errors in the BASIC program. Note the corrections in the next "Aerial View."

A Big Hand To . . .

. . . all those who contributed to this month's QRX column. They are: *Westlink Report, Ground Wave, BNT Bulletin, W4CA Log, LCARA Patch, ANARC, Milliwatt, QRZ*, Bob Newkirk, Tselil Harmoni, K6DUE, NT2X, ARRL, JARL, CARF, KB4KCH, WB9WDH, WA9QDZ, and NX5Z. Keep those photos and news items rolling in to *73 Magazine*, Forest Rd., Hancock NH 03449. Attn: QRX.

Spread-Spectrum

A fascinating mode—and legal for hams to use!

by André Kesteloot N4ICK

First, a trivia quiz for World War II buffs:

Question: What did movie star Hedy Lamarr in Hollywood and German General Rommel in Libya have in common?

Answer: Spread-spectrum! General Rommel used a spread-spectrum (SS) communication link between Germany and Derna, Libya; and in 1941 actress Hedy Lamarr obtained one of the original patents in the US on frequency-hopping spread-spectrum.[1]

If nothing else, the above should tell you that spread- spectrum is not new by any stretch of the imagination. Why is it, then, that 48 years after the beginning of World War II, spread-spectrum still evokes in many the idea of stealth and secrecy, rather than spectrum management?

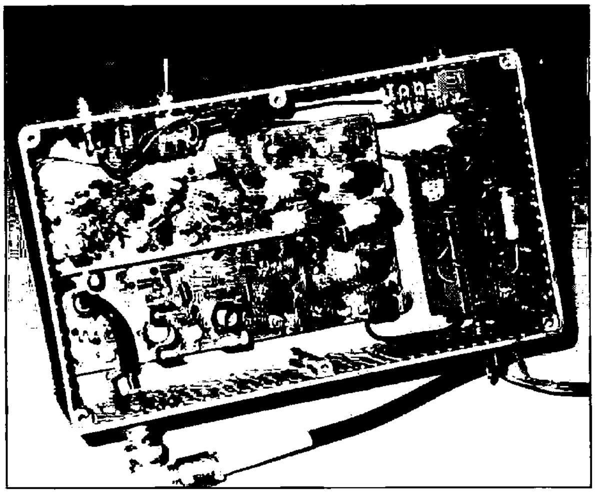


Photo A. An SS transmitter. A modified Hamtronics 440 MHz exciter drives a final amplifier (not shown in photo). The board to the right includes a pseudo-noise generator and pre-scaler divider chain.

The Spread-Spectrum Transmission

To qualify as "spread-spectrum," a transmission must meet the following criteria: (a) the bandwidth must be independent of the modulating signal; (b) the bandwidth must be much larger than those for traditional modulation schemes; and (c) data recovery must be achieved by synchronizing a code at the receiver end of the link.

Although there are many types of spread-spectrum modulation schemes, only two are authorized by the FCC for radio amateurs: frequency-hopping (FH) and direct-sequence (DS).

Frequency-Hopping

In frequency-hopping, the transmitter transmits for a short time on frequency F1, then hops to frequency F2, then F3, etc. Although the hopping pattern appears to be random, it is in fact predetermined (pseudo-random). Communication can only take place if the receiver knows the hopping sequence and synchronizes its hopping to the transmitter's.

If we take, for instance, a hopping sequence of 127 discrete frequencies, and we are faced with interference on discrete frequencies F3, F16, and F57, reliable transmission of information will still take place 124/127 of the time. Because of the redundancy in human speech, this system should be particularly attractive to those operating in heavy interference.

Direct-Sequence

In direct sequence, generally a carrier (say 446 MHz) is mixed in a doubly-balanced mixer with a pseudo-random sequence (clocked at, say, 2.78 MHz). In the process, the carrier will be canceled and replaced with a noise-like spectrum of a bandwidth several Hz above and below the original carrier.

Of the energy transmitted, however, 90% will be concentrated in a band between 443.12 MHz (446−2.78) and 448.78 MHz (446 + 2.78) in this example. At the receiver end, only a minor rise in the noise-floor will appear around your frequency (see Figure 1), but after successful de-spreading, the original carrier will be recovered (see Figure 2).

Advantages and Difficulties

Some of the advantages of spread-spectrum are:

Better frequency spectrum utilization. Since a non-correlated receiver hears nothing

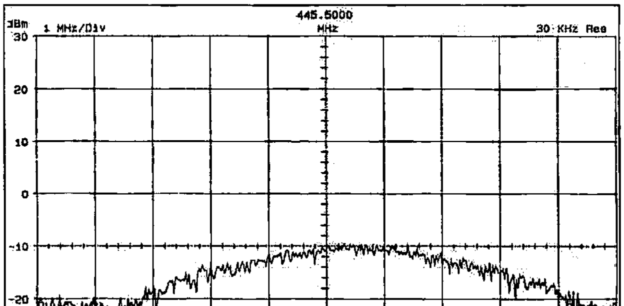


Figure 1. A Direct Sequence (DS) spread-spectrum signal, reception. Only a minor rise in the noise-floor will appear around your frequency.

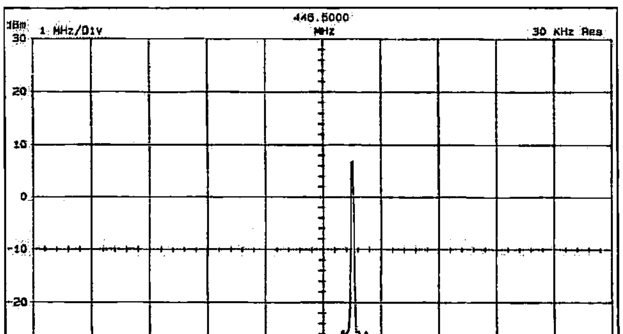


Figure 2. The recovered signal after successful de-spreading.

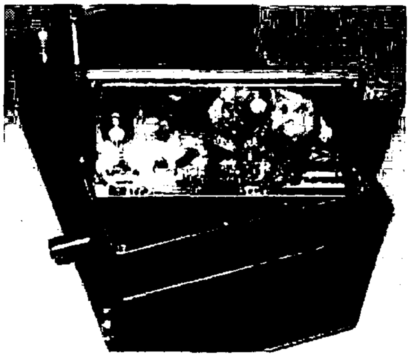


Photo B. An SS receiver. It is a doubly-balanced enclosure, where a locally-generated PN signal mixes with the incoming RF signal from the preamplifier. Note the strip-line construction, and the two MMICs, clearly visible near the two BNC connectors on the left and right of the photograph.

but noise, you can allow multiple transmissions on the same frequency band, with several transmitters literally on top of each other.

Secure communications. Depending on the sophistication of the pseudo-noise code, unauthorized parties may find it very difficult to recover the original modulation.

The ability to reject interference. Unless the interference is actually synchronized onto the transmitted information, it will not appear at the receiver output. Spread spectrum transmissions are thus inherently more resistant to interferences.

In both cases FH and DS, the most difficult process to control is synchronization between transmitters and receivers. More time, more money, and more energy have been spent on that problem than on any other spread-spectrum problem.[2] How do you synchronize on a signal which you can neither see nor hear?

In addition, spread-spectrum has not been used much outside of the military (and, more recently, space communications) because the circuitry is complex and the cost is high. The latter has helped keep frequency-hopping and direct-sequence either in the classified or proprietary domains.

A simple, albeit slow, synchronization system for amateur radio purposes, designed by the author, appears in the 1989 *ARRL Handbook*, Chapter 21, page 15.

Neither would be difficult to "break" if we were interested in secret/secure radio communications, but as amateur radio operators, by definition we are not. However, this explains why one of the major advantages of spread-spectrum for the military (low probability of intercept) directly translates in the radio-amateur world as low probability of interference.

An Invitation to Discovery

Incidentally, neither of the systems mentioned above uses hard-to-find or expensive parts. You can generate pseudo-random noise with shift-registers. You can construct simple ones with as little as two ICs (74164 and 7486, for instance), while doubly balanced-mixers are readily available for about $5. This is an undisguised invitation for you to try your hand at spread-spectrum experimenting!

But, you will say, why bother with spread-spectrum in the first place? For one thing, because of the spectrum utilization problems we are all facing. We all want to squeeze more and more transmissions into well-defined bands, and something will have to give. With spread-spectrum, you can get additional frequency utilization.

Another fascinating angle of this technology, surely, is that there is still so much to discover, improve upon, and develop in spread-spectrum. This would be a fabulous way to put our virtually unused microwave bands to good use—there, in spread-spectrum, you could try all sorts of new modulation schemes! High speed data transmissions and spread-spectrum television come readily to mind.

If this article has been able to whet your appetite to learn more on the subject, the references mentioned below and the *ARRL Handbook* are a good place to start.

AMRAD, the nonprofit Amateur Radio Research and Development Corporation, has been experimenting with amateur spread-spectrum since 1980. If interested, write to *AMRAD, PO Box 6148, McLean, Virginia 22106-6148.*

References

[1]R. Scholtz, "The Origins of Spread-Spectrum Communications," *Spread-Spectrum Communications*, p. 7. New York: IEEE Press, 1983. R. Price, "Further Notes and Anecdotes on Spread-Spectrum Origins," ibid., p. 41.

[2]R. Dixon, *Spread Spectrum Systems*, p. 214. New York: John Wiley & Sons, 2nd Edition, 1984.

Photo C. Complete 440 MHz direct-sequence amateur spread-spectrum setup. The transmitter is on the left; the receiver on the right. Die cast aluminum boxes provide mechanical rigidity and shielding.

73 Review *by Michael J. Geier KB1UM*

Yaesu FT-411 FM HT

Ever smaller and fuller featured. . .

Yaesu USA
17210 Edwards Rd.
Cerritos, CA 90701
(213) 404-2700
Price Class: $350

Yaesu has a long tradition of innovation in HTs. From the first digital-display, microprocessor-controlled walkie (the FT-207R) to the first dualbander (the FT-727R), they've led the way, defining the new frontier. This tradition continues with the introduction of the FT-411.

The 411 is part evolution, part revolution. It packs into a shirt-pocket-sized radio all the features of the larger rigs and adds some terrific abilities never before seen.

Basics

Receive frequency coverage is from 130–174 MHz, and transmit is from 140–150. There are 49 memories (actually 50, if you count the second VFO), and each one can hold everything from CTCSS tone and status to separate RX and TX frequencies, for odd split operation. By the way, the CTCSS encode/decode unit is a standard feature, included in the price and factory installed. (I hope other manufacturers follow suit.) The 16-button keypad controls almost all functions, including HIGH/LOW power selection. There are no hidden switches on the back. In fact, the only other controls are the volume, squelch, tuning knob, and "call" memory button on top, and the PTT, lamp, and monitor on the side, where you'd expect them.

The radio is small and light. The back is metal alloy and the front is plastic. It fits into my hand very well and feels quite solid. The antenna is fat and substantial but is also very rigid. A more flexible duck would be welcome. The keypad buttons are soft rubber, as are the PTT, lamp, and monitor buttons. There is a rubber grommet around the antenna jack, and the rig seems fairly weatherproof.

Included is a 600 mAh NiCd battery, as with most new rigs. The wall charger connects through a small jack on the back, and you can operate the rig while the battery charges. Of course, with a very depleted battery, it may not operate too well, especially on transmit. For receiving, it works fine, as long as the battery has some charge on it. The FT-411 uses the same batteries as the FT-23R series, and optional batteries for higher power or longer operating time, as well as AA and AAA packs, are available.

Features Galore

Where do I begin? This rig has every feature

I've ever seen, and a few new ones. Frequencies may be entered in several ways. You may use the tuning knob, the UP/DOWN arrow keys, or you may key in the frequency directly from the keypad (my favorite method). When using the knob or arrow keys, a press of the FUNCTION key makes them step the VFO in 1 MHz steps. I should say VFOs, because there are two of them! Emulating modern HF rigs, VFOs A and B are identical in function and can be toggled between with a press of the VFO button.

Operating data is displayed on a front-mounted LCD, showing frequency, memory channel number, VFO A or B, and a host of other things. The display can be backlit by pressing the lamp button, above the PTT switch. The keypad lights up at the same time, making night operation very convenient. LEDs are used for the keypad, but the LCD is lit with an incandescent lamp, something I'd hoped we'd seen the last of. It is very bright, though, and makes the LCD easy to read. The lamp has no timer; you must keep the button pressed as long as you need it, so two hands are required.

Band and memory scan are provided, along with two special-purpose memories used to set upper- and lower-band scanning limits. You can set the scanner to pause for five seconds on each busy channel (great for public service band scanning) or to wait until the carrier drops, which I prefer for ham repeater use. The scan is very fast, about 14 VFO steps or memory channels per second. It really zips through the band.

There are 48 general-purpose memories, and one "call" memory. It behaves like all the other ones but is selected via a top-mounted button. It's very handy for hamfests and simplex use or can be programmed with your favorite repeater frequency, for quick access.

Memories may be locked out in two ways. SKIP hides the memory channel from the scan, but it's still there for manual selection (Yay!). It's great for the NOAA weather channel, or a very busy repeater. HIDE erases a memory completely, except that you can "unhide" it later and get it back. I find this feature to be especially useful for travel. I often commute between three cities, so I put the repeaters for each into banks of ten. i lock out Boston and Miami (using HIDE) when I'm home in Vermont, and then unhide them when I go. Each memory channel must be hid and retrieved separately. It would have been nice if there were some way to manipulate whole ranges (such as 10–19) at a time, but it still beats having to re-enter all those frequencies.

The memories normally act as fixed frequencies, but a press of the MR button makes any memory into a tunable VFO! It will even scan up or down the band from the memory. After arriving at a new frequency, you can store it in any memory channel or a VFO, or simply return to your original memory channel, disturbing nothing.

Continued on page 18

Continued from page 14

The priority watch function can sample any memory channel. It can also step through the memory channels, incrementing once each sample. It'll even do all this while you're scanning through the band!

All in all, the memory management features of the FT-411 are the most flexible I've ever seen, and the operations are surprisingly easy to do.

. . . And More Features

Battery saver and "Auto Power Off" (APO) functions are both programmable and defeatable. The saver can be programmed from 0 to 1 second "sleep" time between channel checks, and the APO can be set for 10, 20, or 30 minutes, or infinity. Being able to shut the battery saver off makes the rig usable for packet operation, as no packets will get lost while the receiver is asleep. A longer APO time of, say, one hour, would have been nice.

VOX circuitry is built in, and HIGH or LOW sensitivity can be selected. Use of this feature requires an optional headset. CTCSS tones are selected via the tuning knob and are shown on the LCD. The keypad and PTT may be locked, preventing accidental changes or transmission. Both the standard repeater offset and VFO steps are selectable. Automatic offset selection, per the band plan, is provided and can be both overridden and defeated. Finally, a "bell" feature signals you when a station sending your selected CTCSS tone is received, whether you're in CTCSS or not.

Autodialer

This radio has a ten-number DTMF autodialer! It stores numbers of up to 15 digits each, sending them at the touch of a button. If you're a control op or use an autopatch, it's just great. The procedure for entering numbers is a bit cryptic and could have been done better, but it's worth getting the hang of it. Especially for portable operation, this is one feature that will make you wonder how you ever got along without it. Of course, DTMF may also be manually sent.

Documentation

With all these features, some good instructions are in order, and they are provided. The book is written in clear English and takes you easily through the operations. Also, a wallet-sized "crib card" set is provided.

Comparisons

I couldn't help but compare the 411 to my Kenwood TH-25AT, a rig I just recently reviewed. Here are some observations:

Mechanical: The Yaesu is slightly smaller and noticeably lighter than the Kenwood. I find the front-mounted LCD easier to use, though the top-mounted one on the Kenwood is better protected from scratches. Both rigs feel good and solid.

Features: The Yaesu does everything the 25AT does, and lots more. Unique 411 features include 49 memories, direct frequency entry, and autodialer.

Transmitter: Audio reports indicate that the Kenwood is "bassier" but more natural, while the Yaesu is punchier and more "communications" styled. Output power in the HIGH position is the same, but the Kenwood seems a bit stronger in the LOW position. There is no mention in the Yaesu specs of the output in the LOW position.

Receiver: The Yaesu has wider coverage, and selectivity is better. The Kenwood, with one of the "hottest" receivers I've ever seen, makes clear audio from signals the 411 doesn't even hear. But comparisons with other rigs show the Yaesu to be about average, and certainly adequate—any repeater you can hit, you can receive.

"This radio has a ten-number DTMF autodialer!"

The Kaboom Audio Enhancer

My principal complaint about this radio is that the audio output power is just too small. In addition, the FT-411's speaker has a tinny, fuzzy quality. There's an easy way, however, to improve this.

A big part of the audio problem is acoustical. The interaction of the speaker with the size and depth of the grille greatly affects the volume and sound quality. Deliberately blocking part of the speaker causes a significant increase in volume, along with a reduction in fuzziness. The improvement is caused by the creation of a resonant chamber between the speaker and the grille front.

Go to an art store and get a clear adhesive plastic film with paper backing. If you can't find this, substitute with wide adhesive tape, as long as it is fairly thick. Cut out a piece 1″ wide by 13/16″ long. Cut out from the 1″ wide piece a center piece 3/16″ wide by 5/16″ long.

If you hold the rig so that you're looking into the grille from the bottom, you can see the slot for the microphone in the upper left corner, and also the vertical center post in front of the speaker. Wipe the grille with a tissue, peel off the paper backing from the back of the plastic film, and paste the film onto the rig with the top edge centered over the top horizontal slot, and the hole centered over the vertical post. The left edge of the film should just clear the right side of the mike slot. Exact placement isn't critical. Finally, using your fingernail, bend the edges of the film into the top and bottom slots.

That's it—the radio will now sound a whole lot better and you haven't even voided your warranty!

Nit-Picks

The manual, while easy to read, omits a great deal. Although a full schematic is provided, audio output and TX current drain specs are given at 12 volts, so I have no idea what they are with normal 7.2-volt battery use (they should be a lot less). No mention is made of the lithium battery, nor of how to wire a microphone for the rig. You can review the contents of an autodialer memory using the arrow keys, but the subject isn't mentioned in the book; I discovered it by accident.

There are a few birdies in the receiver, well outside the ham bands, but this seems to be typical of wide-coverage rigs and isn't a big deal. Also, two strong local signals show up where they shouldn't, and I can't find them on my 25AT. They appear to be images, or some sort of intermod.

The programmable band scanning will not stop at the limits specified in memory if either limit memory is set for SKIP. Thus, those memories will also appear in your normal memory scanning, unless you want to hide or skip them and then retrieve them each time you wish to use the programmable scan feature.

You may find the musical-scale keypad beeper annoying, because of the double beeps and tunes used for the arrow keys and scanning. Luckily, it can be completely turned off.

The Auto Power Off warning beeper only works when the keypad beeper is active. So, if you turn off the keypad sounds, you really can't use the APO function, because it will shut the rig down without any warning. I discovered this while waiting for a call that never came . . .

The icons on the LCD are very tiny and hard to see. You soon begin to recognize them, however, by their positions on the display. Also, the reflector behind the LCD seems set far back, and light entering at an angle causes blurring of the image.

The RF power output display is generated by the micro and is not a measurement of actual output. It reads full scale in HIGH power, and about ⅓ in LOW power, and will show full output even as the battery dies. Since there is already a "low" indicator for low power, this feature is redundant.

Although there is a low battery warning icon, there is no other voltage monitor, so you can't tell the difference between a fully-charged battery and one about to die. That was one nice feature on the TH-25AT.

The keys are tiny and close together, and large fingers may have a hard time pressing them. A still necessary price to pay for having a full-featured rig you can drop in your pocket.

The radio comes with a very nice padded soft case, but no belt hook. The hook costs extra. Also, the case has no loops for belt use.

The battery pack is plastic rather than metal.

As usual, the lithium battery is buried somewhere inside, with no mention of how to change it.

Also as usual, there is no DC input jack. You must buy an adapter which slides on in place of the battery.

Conclusion

This is the most advanced single-band HT available today. Despite the list of nit-picks, its bevy of features makes the FT-411 an outstanding value. If you want a powerhouse of features in your pocket and can live with the low audio output, this is the rig of your dreams. 73

Number 6 on your Feedback card

QRP CW Transceiver

A great little do-it-yourself DC rig for the 30 or 40 meter band.

by Bruce Auld NZ5G and Bill Heishman N5HNN

Photo A. Front panel of the QRP transceiver. The Receive Incremental Tuning (RIT) control allows you to adjust the receive frequency without changing your transmit frequency.

Much of the fun in amateur radio comes from having "done it yourself." In my search for a project that would yield a unit with satisfying performance, I found two common problems: The writer assumed too much knowledge on the part of the builder, and the parts were not widely available.

This project is different. The builder gets a running start in home-brew with something that will deliver plenty of fun and performance, and the parts are available to anyone with access to a Radio Shack store.

This is a 3-Watt, single circuit board, 40 or 30 meters, VFO-controlled CW transceiver, featuring a direct conversion receiver with audio filtering, Receiver Incremental Tuning (RIT), and speaker level audio volume. It is based upon the classic design by W7EL with a few alterations. My partner (and technical genius) in this project, Bill Heishman N5HNN, and I put it together as a club project for the Arlington Amateur Radio Club.

Theory of Operation

The direct conversion receiver and transmitter described in this article are quite simple. Much of the technical information you might want to know, and the rationale behind specific design choices, has been expertly described by Roy Lewallen W7EL ("An Optimized QRP Transceiver," *QST*, August 1980).

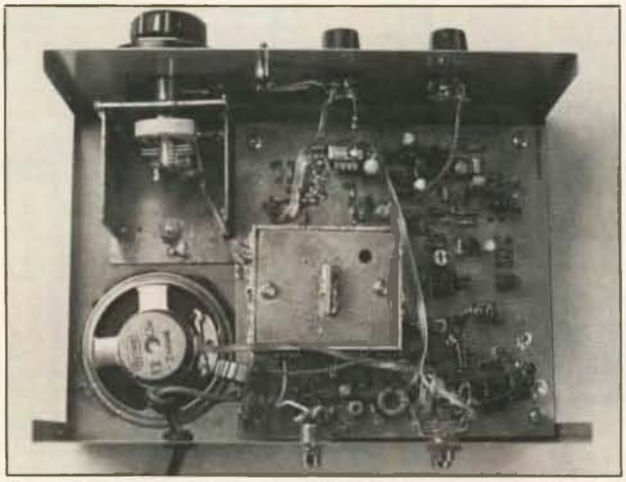


Photo B. Top view of the inside of the QRP rig. Note the double-sided PC board, for improved grounding. The VFO RF shielding (upper left) is easily tack-soldered on.

The best way to get over the initial fright of looking at the schematic diagram is to break the circuit down into modules and see how simply the modules connect to one another. Theoretically, the modules could be built separately and then interconnected with a few cables. For simplicity, all the modules are located on a single board.

Refer to the flowchart and schematic diagram, Figures 1 and 3. Beginning with the transmitter, the transmit frequency is generated by Q1 and its associated components in the VFO. The buffer, Q2, isolates the oscillator from the other circuitry to help keep the VFO stable. Q3 builds up the signal to a more usable level. The driver, Q4, amplifies the signal. The final, Q5, amplifies it to the 3-Watt level.

You key the transmitter by turning the power to the driver on and off, using Q6 as a switching transistor. Select the frequency by varying the tuning capacitor, C2. The transmitter is that simple!

The VFO frequency feeds into the diode-ring mixer, and is mixed with the incoming 7 or 10 MHz signal. The difference, or "product," is the audio frequency you eventually hear from the speaker. That is why this stage is also called a "product detector." All the circuitry after the mixer builds up the audio signal to speaker level: Q8 preamplifies the signal a little, U2 is an audio filter that attenuates the audio signals above about 700 Hz, and U3 amplifies the signal from the audio filter to listening level. That's it!

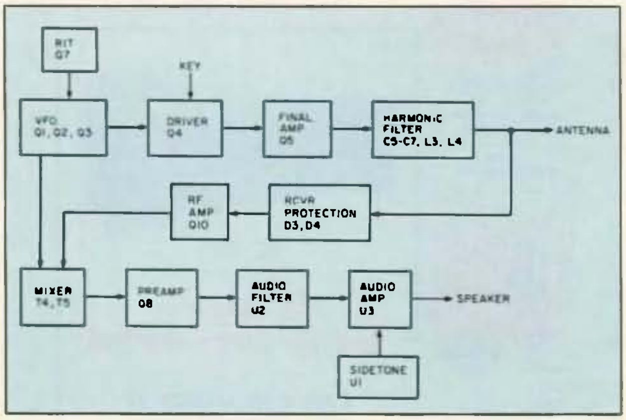


Figure 1. QRP transceiver flowchart. Note callouts (Q1, Q4, U2, etc.) which help you locate that section of the transceiver on the schematic.

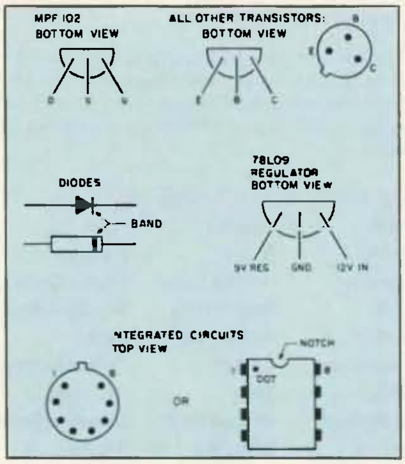


Figure 2. Base diagrams for the semiconductors used in this project.

Specific Rig Components

VFO: The VFO is a simple, well-known Hartley circuit. Drift is minimal. Frequency generation is mostly dependent upon the L1 and capacitors C1–C4. When plotted out, these components yield the VFO's operating frequency. C2 is the main tuning capacitor, and C4 is a miniature trimmer. This is important for

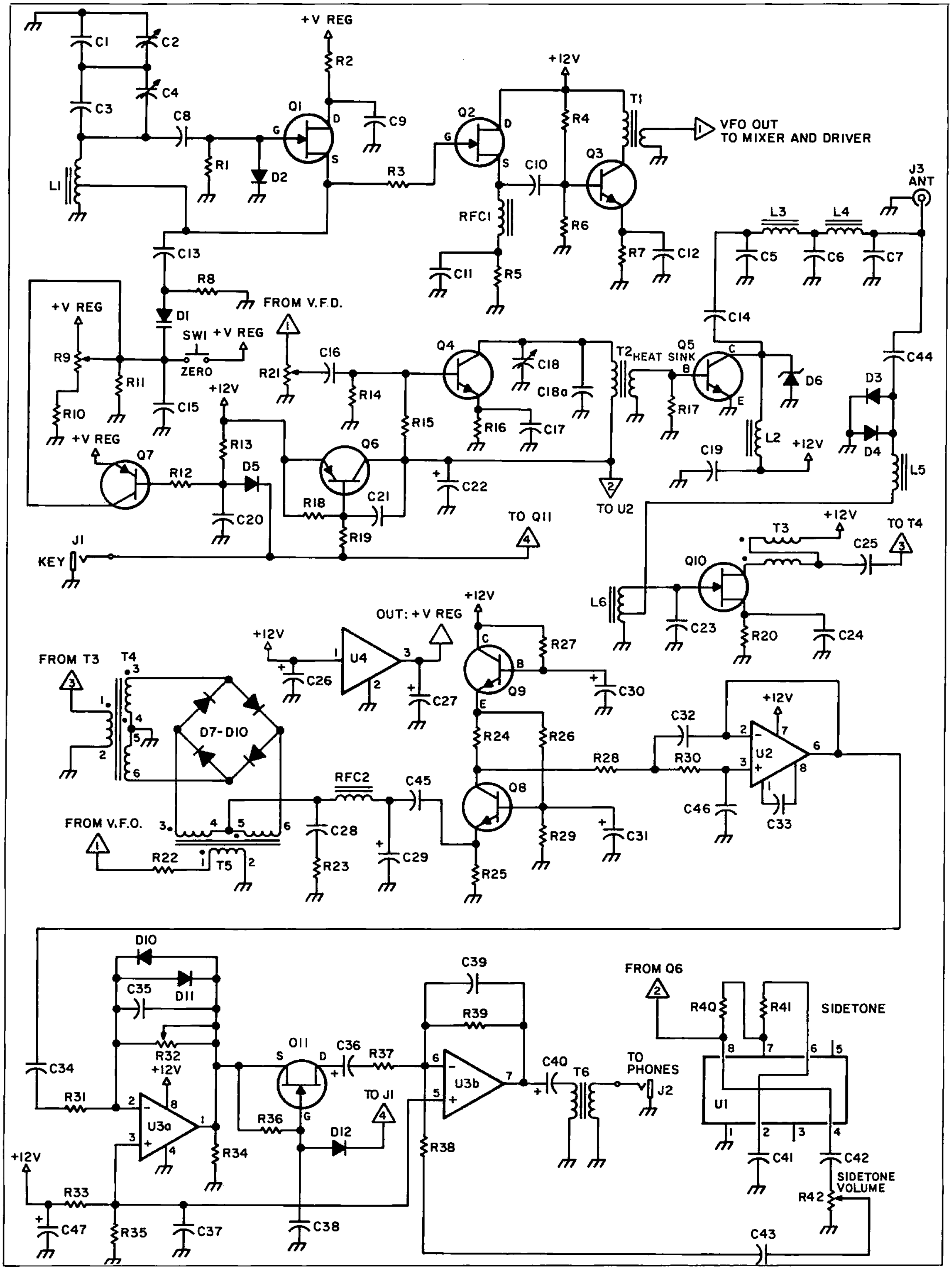


Figure 3. Schematic for the QRP transceiver.

zeroing the frequency of the VFO to calibrate it to the proper range. The remainder of the capacitors, C1 and C3, should be NPO ceramic or polystyrene. These provide the necessary stability. Regular ceramic capacitors will cause the VFO to drift.

The 5 pF capacitor off the tap of L1 couples the tank circuit to the diode that provides RIT and the transmit frequency offset. It is switched in and out by Q7. The offset shifts the frequency of the rig in the transmit mode approximately 750 Hz down. This is the standard offset in the amateur community. If there were no offset, you would be exactly zero beat with the other station, and neither of you would hear the other!

RIT: The Receiver Incremental Tuning (RIT) circuitry is probably the handiest of "bells and whistles" on this rig. This provides a method of moving the receiver frequency while the transmit frequency stays put. This is useful for adjusting the frequency of the tone of the station you are listening to, but leaving the transmit frequency stationary. Consequently, your frequency will not appear to the other station to crawl up the band.

Driver: The NPN driver transistor (Q4) is driven at a fairly high level from the VFO and is matched to the final through T2. The transformer is parallel with a 5-50 pF trimmer capacitor (and an additional 22 pF or 33 pF capacitor for 40 meter operation) which, together with the inductance of the primary winding of T2, provide a resonant circuit. This tuned circuit is more complicated than a broadband design, but allows more power output.

Amplifier: The final specified is the much written-about 2N3553. It gives plenty of output but, unfortunately, it is expensive and not always easy to find. Radio Shack carries a 2N3053 which will suffice, but this drops the output to about one and one-half Watts. Other possibilities are a 2N3866, 2SC2075, or MRF 476.

The output transistor must have a heat sink! If you neglect this, it will overheat and destroy itself! The output from Q5 is fed into a conventional double Pi low-pass filter network to reduce harmonics.

Receiver Protection Circuit: The transmitter and receiver sections connect directly to the antenna. You need circuitry to protect the receiver portion from the power of the transmitter. Otherwise, the 3 Watts from the transmitter will ruin the front end of the receiver. The diodes, D3 and D4, together with the resonant combination of C44 and

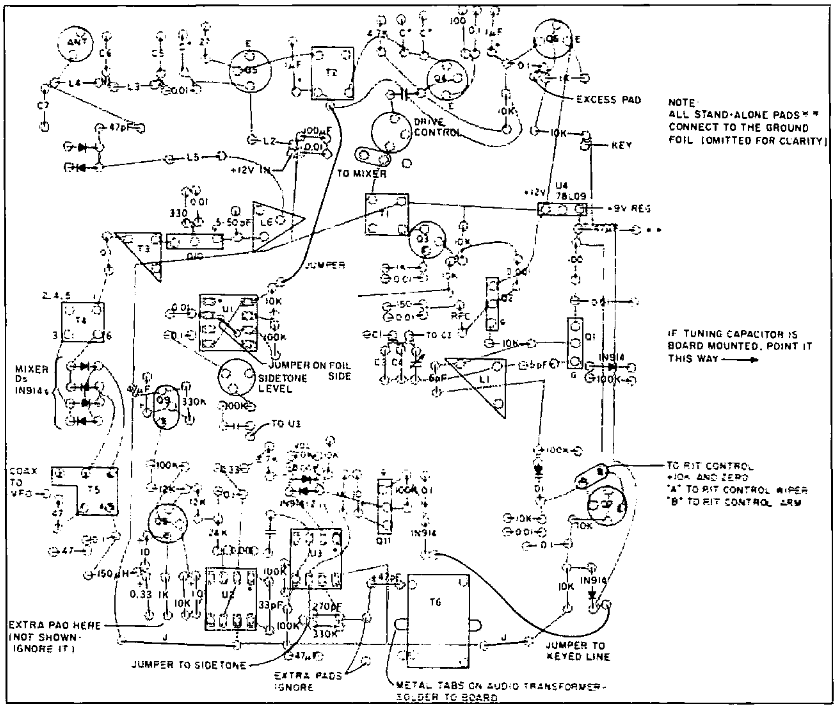


Figure 4. Parts placement guide for the QRP transceiver.

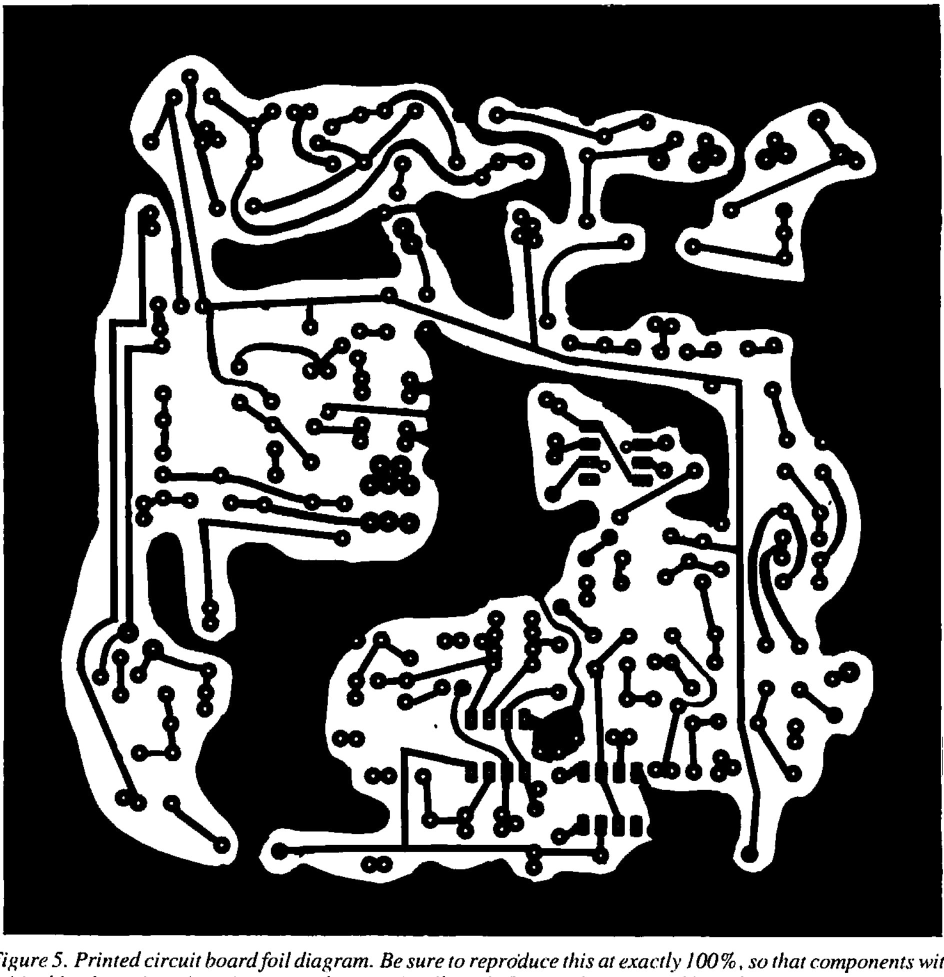


Figure 5. Printed circuit board foil diagram. Be sure to reproduce this at exactly 100%, so that components with critical lead spacings (e.g. intergrated circuits) will easily fit onto the prepared board.

Table 2: Frequency Dependent Values

Part	30 Meters	40 Meters
C1,3	150 pF	200 pF
C5,7	270 pF	470 pF
C6	560 pF	1000 pF (equals 0.001mF)
L1	27 turns, #26 wire, T-50-6 toroid	34 turns, #26 wire, T-50-6 toroid
L3,4	12 turns, #22, T-50-2	14 turns, #22, T-50-2
L5	34 turns, #28 or 30, T-50-6	50 turns, #28 or 30, T-50-6
L6	45 turns, #28 or 30, T-50-6	45 turns, #28 or 30, T-50-2
C18a		Radio Shack 272-1437 (22 pF)

These parts must be obtained from either Radiokit, Circuit Specialists, or Mouser (except C18a).

L5, prevent this problem.

RF Amp: This device amplifies the incoming received signals to give the receiver a little more punch and better signal-to-noise ratio.

Mixer: The mixer is a doubly-balanced mixer using the common 1N4148 or 1N914 diode. The difference between the antenna's signals and the VFO's frequency yields the audio frequency appearing at the speaker. This is the most fearsome looking part of the circuit. It is actually the most fun to build.

Audio Chain: The preamp, Q8, in conjunction with U3, amplifies the audio to listening level. The audio filter U2 is a low-pass filter of conventional design. It cuts off at approximately 700 Hz.

Some Simple Rules of Home-brew

You can build this project quickly and easily if you observe a few simple rules that are common to any hobby or craft. These are absolutely indispensable:

- Know the rig. Study the schematic and plans very thoroughly. Be familiar with the modules and know what they are designed to accomplish.
- Know the parts. Be familiar with what parts make up the project. Study the parts placement guide, Figure 4, and match the flow of the circuitry against the parts placement guide. Also, remember that you can destroy a part by reversing polarities, etc.
- Go slowly! This one piece of advice will save you hours of teeth-gritting tension and frustration later. There is no exception to this rule.
- Go methodically. Build this project module-by-module, where possible. This will help to prevent many possible problems and will enhance the learning potential of this project.

Order of Construction

Do not be afraid to etch a single- or double-sided circuit board yourself. Copy the foil pattern (Figure 5) directly onto Tech-200 film (Tech-200 is supplied by the Meadowlake Corp., PO Box 497, Northport NY 11768), which is etch-resistant, or purchase supplies from Radio Shack. Otherwise, get a circuit board from a supplier. (Midland Technologies, 34374 E. Frontage Road, Bozeman MT 59715, 406-586-1190. Contact is Lee Lester. Double-sided tinned PC board, price $12.50 plus shipping and handling.) There are also a limited number of complete parts kits available, including printed circuit board. (Tanner Electronics, 1301 West Beltline Road, Carrollton TX 75006, 214-242-8702. Contact Jim Tanner. Complete kit, less case, is under $73.00.)

Modular Approach

I leave this to the whim of you, the builder, but consider these suggestions, which follow the modular approach.

VFO: Assemble the VFO components through T1 first. C2 is an air variable. You can mount it on the front panel, or on one of four PC board square "walls" that can be soldered to the board to shield the VFO from the rest of the components of the rig. After you have completed the VFO, apply voltage to it. Place the board near the receiver antenna connection to find the VFO frequency in a general coverage receiver. Note how C2 and trimmer C4 change the frequency. Set the tuning capacitor to its fully-meshed position and adjust C4 for the low frequency of the segment of the board you wish to work. A vernier dial for the VFO is nice but not essential.

You may need to do some experimenting to get the frequency exactly at the right spot. Also, you may have to add or subtract a small amount of capacitance (remember: NPO or polystyrene), no more than 20 pF or so. Adding capacitance will lower the VFO frequency.

RIT: Assemble the RIT circuitry. Note that the RIT control R9, and the resistor R10 connected to it, are not board-mounted. Apply voltage to the circuitry. Notice that when you close the key the transmit frequency will be changed. Note also that when you rotate the 10k pot without the key closed the frequency changes. Setting the pot at zero resistance sets the receiver at the transmit frequency. Rotating the control gives the offset. If you experiment enough, you'll find a good offset. SW1 is a "zero" button, which allows instant reference to the transmit frequency.

Transmitter: Assemble the remainder of the transmitter slowly, paying careful attention that parts are assembled on the board neatly and correctly. Connect a dummy load and key. Ground R19 off the base of Q6, which will key the transmitter. A wattmeter will verify the output. Tweak the output with trimmer C18. Turn drive control R21 (board mounted) until the output is 3 Watts. In some cases, R21 may cause the transmitter to become unstable. If so, consider omitting it.

Receiver: Assemble the remainder of the receiver. There is no easy way to compartmentalize it in any smaller components, so you must assemble most of the receiver section at one time. However, if you wish, you can omit the RF amp for the time being, route the antenna directly to T3 of the mixer, and assemble the RF amp after you're sure that the remainder of the receiver works properly.

Sidetone: Assemble U1 and its associated components. The trimpot adjusts the volume of the sidetone into the last audio stage. The sidetone level is independent of the volume control. Don't forget the jumper to U3!

Construction Hints

There are a number of hints that might help you to assemble the rig and to avoid blowing up parts.

- Parts are generally noncritical, except in tuned circuits. I tried to stick to common values. If you need to substitute because of a shortage in your junk box, try it. Remember that connecting capacitors in parallel will increase the total capacitance by the sum of their values. This information is useful if you need an NPO cap but don't have the exact value. You might also use polystyrene caps or silver micas, but there may be some drift.
- Refer to the base diagrams of the semiconductors in this project (Figure 2). It is very common to reverse connections of transistors and polarities of diodes, electrolytic capacitors, etc. Make sure you do not switch the diode in the RIT circuit with the other 1N914 diodes.
- Toroids may seem forbidding, but are easier to get the hang of than tying your shoe. The T-50-2 is a red core, and the T-50-6 is a yellow core. The "50" refers to its size (0.50 inch), and the "6" is the core material. The FT-37-43 or FT-37-61 cores are black (use either one, whichever you find).
- The mixer transformers are "trifilar" wound. That is, 3 wires are twisted together 8 turns per inch, and then the twisted group are wound the correct number of turns around the core.

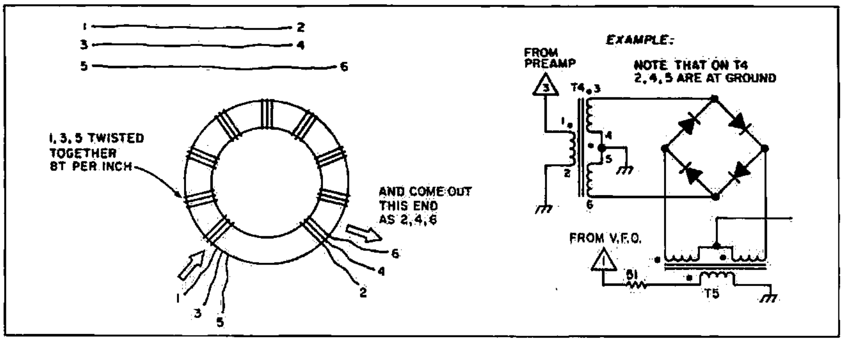


Figure 6. Details on winding toroidal coils. The doubly-balanced mixer in the main schematic (Figure 3) is reproduced here.

TABLE 1: PARTS LIST

Part Callout	Value Description	RS Part No.	Other Supplier
C9,16,20,21,28, 32,38,42,43	0.1µF	272-135	
C11,12,14,17,19,24,25,41	0.01µF	272-131	
C10,35,46	0.001µF	272-126	
C1,3,5,6,7 SEE TABLE 2, FREQUENCY DEPENDENT VALUES			
C2	35µF air variable, panel-mounted		Radiokit, Jackson, 4667-50
C4	15 pF trimmer, NPO or air variable, board-mounted		Radiokit, EF Johnson, 193-0004-001
C8,13	5 pF NPO ceramic		Radiokit
C15,44,47	47 pF	272-121	
C18	5–50 pF trimmer, PC-mount	272-1340	
C18a (40m operation)	33 pF	272-1437 (22 pF)	
C22	1µF	272-1434	
C26	100µF electrolytic	272-1016	
C27,30,37,40	47µF electrolytic	272-1015	
C29,34	0.33µF	272-1433 (0.47µF)	
C31,36,45	10µF electrolytic	272-1013	
C33	33 pF	272-121 (47 pF)	
C39	270 pF	272-124 (220 pF), plus 272-121 (47 pF)	
R1,8,13,26,33,35,36,38,41	100k	271-1347	
R2,16	100Ω	271-1311	
R3,4,6,10,11,12,15,19,29,34,40	10k	271-1335	
R5	150Ω	Use 100	
R7,18,25,37	1k	271-1321	
R9	10k panel mount	271-1721	
R14	4.7k	271-1330	
R17	27Ω	271-007 (33 ohms)	
R20	330Ω	271-1315	
R21	1k PC mount	271-333*	
R22,23	47Ω	271-009*	
R24,28	12k	use 10k	
R27,39	330k		
R30	24k	271-1339 (22k)	
R31	2.7k	271-1335 (2.2k)	
R32	Any panel mount pot, 10k-100k	271-1716 (50k)	
R42	10k PC mounted trimpot	271-335*	
D1	varactor, zener or rectifier diode	276-564 (15v zener)	
D2-D12 (except D6)	1N914 or 1N4148	276-1122	
D6	33v zener (optional)		Radiokit
L1 See TABLE 2: FREQUENCY DEPENDENT VALUES			
L2	10 turns, #26 wire on FT-37-43 toroid		Radiokit
L3-6 See TABLE 2: FREQUENCY DEPENDENT VALUES			
Q1,2,10,11	MPF-102	276-2062	
Q3,8,9	2N2222	276-2009	
Q4	2N2222A	276-2009	
Q5	2N3553		Circuit Specialists
Q5 (optional)	2N3053	276-2030	
Q6,7	2N3906	276-1604	
U1	NE555	276-1723	
U2	LM301 single op amp	276-007 (741 op amp)	
U3	LM358	276-038 or 276-1715 (1458 or TL081)	
U4	78L09 regulator		Radiokit
RFC1,2	100µH molded choke		Radiokit
T1	Primary 15 turns,#26 wire; Secondary 3 turns over collector end of primary, on FT-37-43 toroid		Radiokit
T2	45 turns, #30 wire, T-50-6 toroid		Radiokit
T3	7 bifilar turns, #26 wire, FT-37-43 toroid		Radiokit
T4,T5	7 trifilar turns, FT-37-43		Radiokit
T6	1k to 8Ω audio transformer, clip off center tap	273-1380	
J1,2	Phone jack	274-252	
J3	S0-239 coax receptacle	278-201	
SW1	Pushbutton, normally open	275-1571	
	Printed Circuit Board Etching Kit	276-1576	
	Cabinet	270-253 (Other cabinets available)	
	Enameled wire for toroids	All sizes available	
	Heat Sinks		Circuit Specialists, Mouser Electronics
	Stand-off insulators	276-195	

* These parts are correct values, but are larger than are designed to be placed on the board. Smaller sizes available at other suppliers:

Radiokit	Circuit Specialists	Mouser Electronics
P. O. Box 973	P.P. Box 3047	2401 Hwy. 287 North
Pelham NH 03076	Scottsdale AZ 85271-3047	Mansfield TX 76063
(605) 635–2235	(800) 528–1417	(800) 346–6873

If bought new or unused, cost will be under $73.00!

continued on p. 49

The G3IGU Transceiver

QRP on 80 meters.

by Keith Coates G3IGU

The circuit for the G3IGU direct conversion receiver, based upon the circuit by J. Young in the February 1975 issue of *Radio Communication*, is straightforward. The RF amplifier is tuned, though, and I found that an RF gain control is essential for evening use. The AF amplifier is a simple circuit.

Construction

The layout is not critical. The VFO, AF, and PA are very well screened, with the components mounted on a length of tag strip. The receiver and sidetone generator are built onto paxolin panels (see Figures 1 and 3), and wired up at the rear. The whole transceiver, including the ATU, is built into one box so only aerial and earth connections are required. You may also place batteries inside the case.

You may consider the PA stage odd, with the 680Ω and 10Ω resistors, but I tried several other types of coupling which resulted in accidents to the BFY51. This circuit has never damaged a PA transistor. The actual RF power output will depend upon the transistor you use. Some BFY51s have given DC power inputs of from 850 mW to 1.3 Watts.

The AF filter (L5, L6, and L7) is based on the circuit of J. Young (*Rad Com*, October 1973) using 38 SWG on Mullard ferrite rings, type FX1593. In the prototype, I used scrap ferrite rings, and I could wind only about 200 turns onto them, but they worked all right.

Wind the PA and ATU coils on ferrite rod ⅜" in diameter and 2½" long. Wind 15 turns of 20 SWG, tapping the ATU coil every two turns for aerial impedance matching.

Different values of R20 will alter the drive

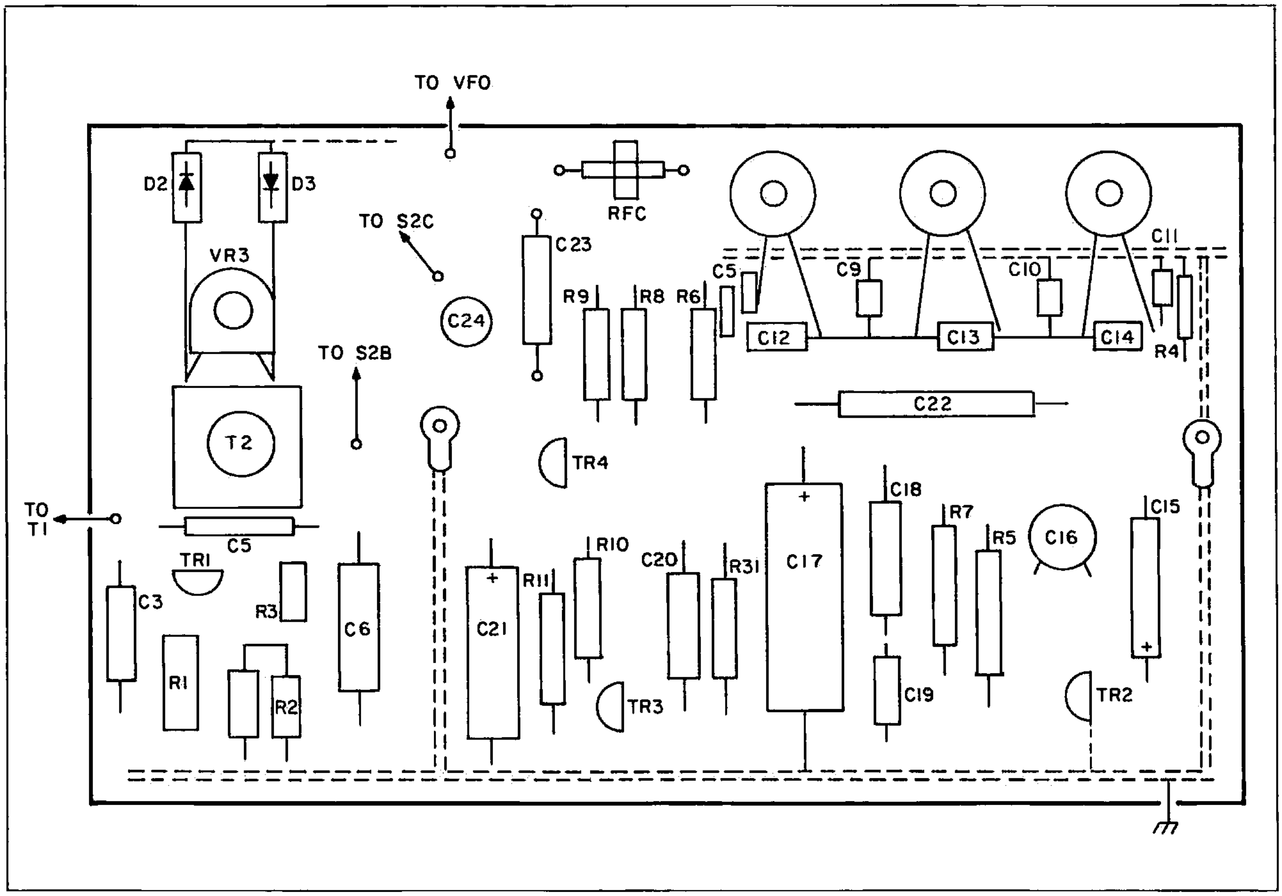


Figure 1. Parts placement for the receiver board.

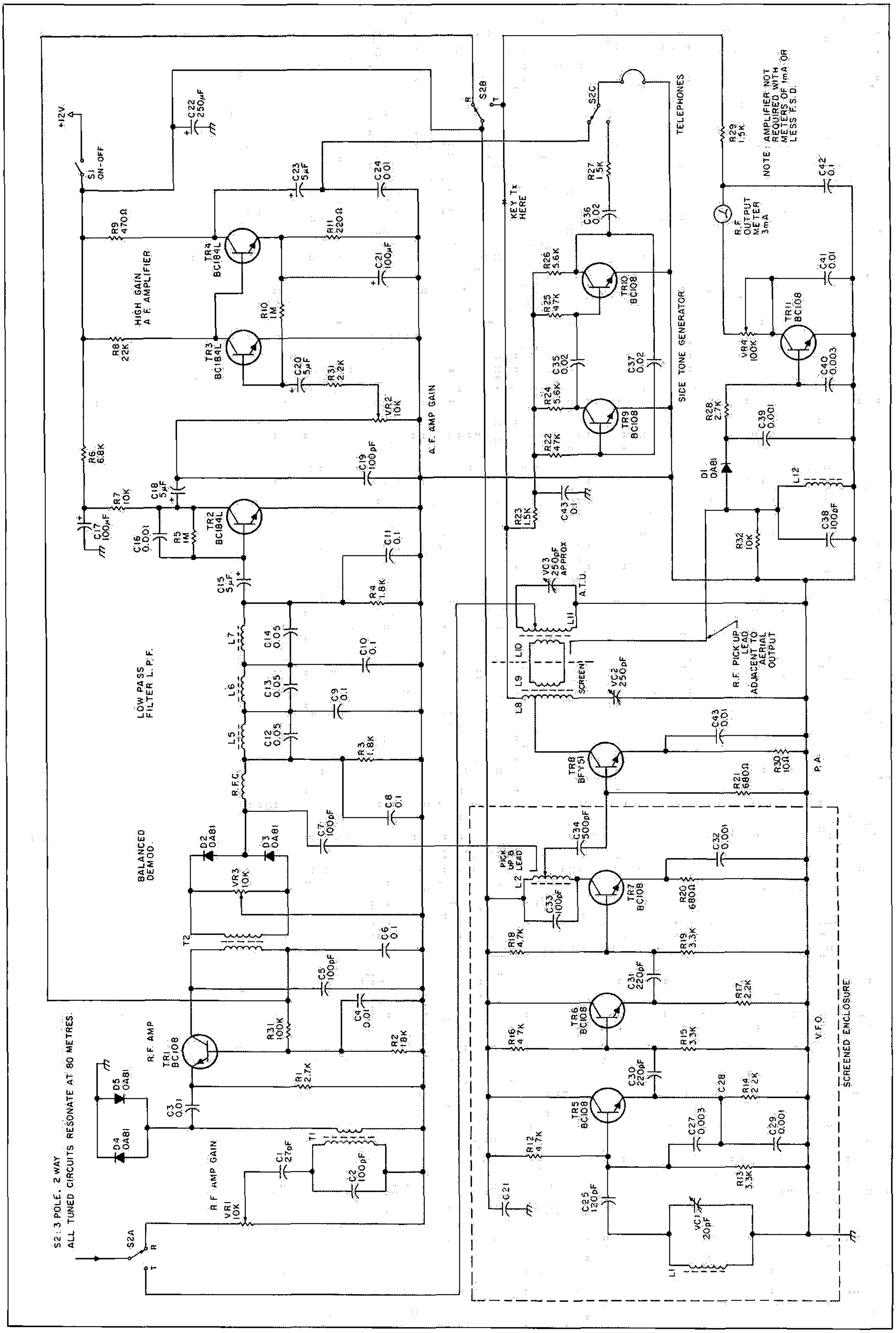


Figure 2. Schematic for the G3IGU 80 meter QRP transceiver.

to the PA, giving different power outputs. A 1kΩ preset in series with a 470Ω fixed resistor will give a variable output from about 200 mW to about 1.5 Watts. This is useful for points in contest operating.

Fit a 500 mA fuse in the 12 volt supply lead, especially if you want to use a car battery—and a diode to prevent reverse polarity accidents.

Suggested Coil Windings

These notes are based on another 80 meter rig I have built, using some of the information in the J. Young article. A grid dip oscillator (GDO) is useful for tuning the coils to resonance.

T1 Primary: 40 turns 30 SWG close-wound on ⅜" former with slug. *Secondary:* 5 turns on earthy end.

T2 Primary: as T1. *Secondary:* 12 turns 34 SWG close-wound in the center of the primary.

L1: 30 turns 30 SWG on ⅜" former with the core, with 100 pF fixed and 50 pF trimmer in parallel to tune onto the CW end of 80 meters.

L2: As primary of T1, tapped about two-thirds up from the earthy end.

L8: 15 turns 20 SWG on ⅜" ferrite rod (2½" long).

L9: About 4.5 turn link on L8.

L10: As L9.

L11: As L8, with tappings about every two turns.

L12: As L2 (or perhaps a 1.5 mH RFC).

L5, L6, and L7: For each inductor, wind 200 turns of #38 wire, closely spaced on the Mullard ferrite rings. Each ring is just under ½" length and ¼" diameter. Mount the rings on the same axis spaced ¼" apart.

So, there you have it. This rig should prove to be a lot of fun to use, especially in the fall months when low-band DX picks up. Enjoy! 73

Adapted from "G-QRP Club Circuit Handbook."

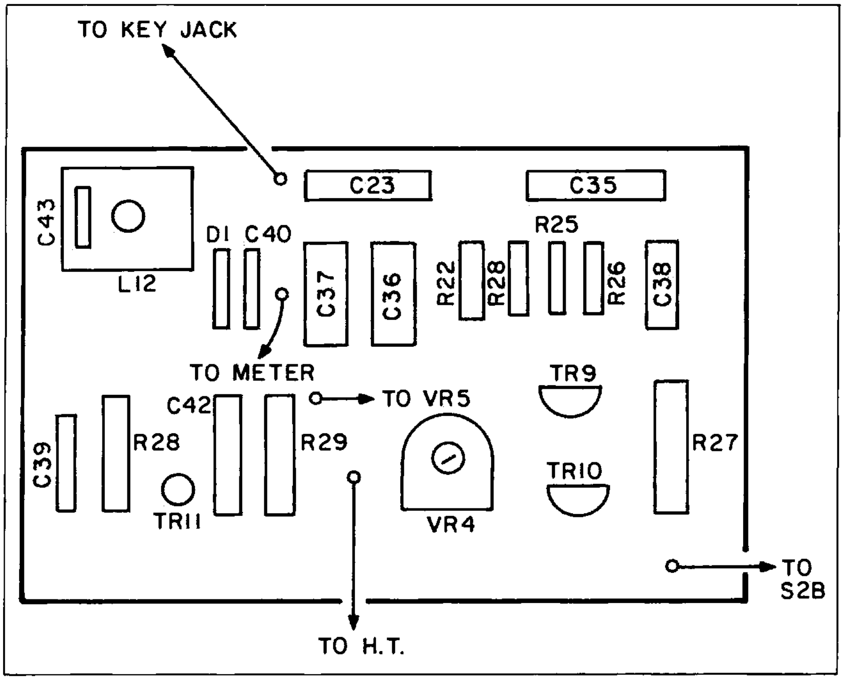


Figure 3. Parts placement for the side-tone generator and RF meter amp.

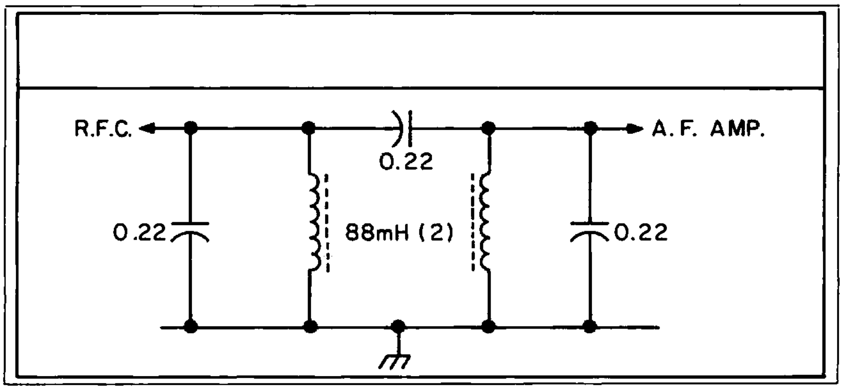


Figure 4. An alternate AF filter.

73 Review *by Marc Stern N1BLH*

The Ranger AR-3500

Competitively-priced QRO 10m rig.

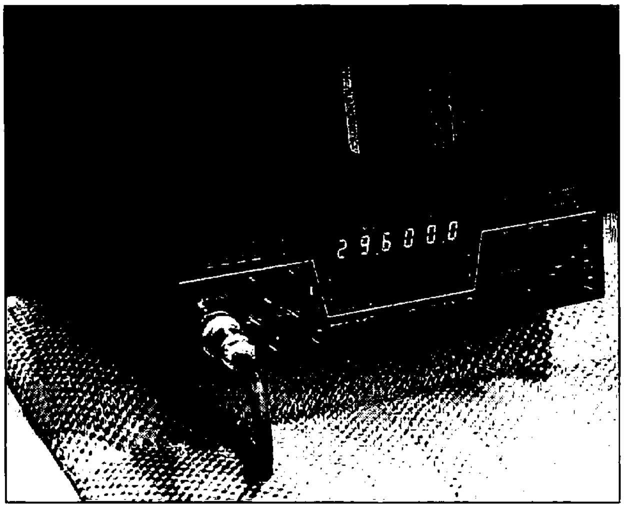
Clear Channel Corp.
Box 445
Issaquah, WA 98027
Phone: (206) 392-0419
Price Class: $350

When I last reviewed a Clear Channel Ranger 10 meter rig, I came to a couple of conclusions. The first was that the rig was a reasonable, all-mode 10 meter transceiver. The second was that it wasn't the most operator-friendly in the world.

After evaluating the AR-3500, a higher-power, updated version of the original, I have found some improvements, and some areas where things are pretty much the same.

In a Nutshell

The Ranger AR-3500 is a microprocessor-controlled 10 meter transceiver with 100 Watts of output. An all-mode rig (AM, FM, SSB, and CW), it features true noise blanking and noise limiting. It has outputs for CW and an external speaker. An amber LED display gives resolution to the nearest 10 Hz. It covers 28.000 to 29.995 MHz and offers splits for repeater use. Specifications put the dynamic range at roughly 105 dBm, and spurious emission suppression meets FCC specifications at about 60 dB down. The Ranger AR-3500 also offers five memories, memory scan, and programmable band scan. It weighs roughly 5 pounds and is about as big as an older 2 meter rig.



The Ranger AR-3500.

Improvements Over the AR-3300

The Ranger AR-3500 is an improvement over the AR-3300, which I reviewed last year, in the following ways:

Instead of using one set of momentary-contact switches for increasing or decreasing frequency, there are now two banks of switches under the display. The top bank is for increasing frequency and the bottom is for decreasing frequency.

There is now a real, highly effective, noise-blanker circuit. You activate it by pushing in the RF gain knob. It pretty much cancels just about all mobile noise.

By pushing in the mike gain knob, you can now activate a true automatic noise limiting circuit. This feature complements the noise blanker and helps limit noise peaks.

The RIT control, called the clarifier, seems to have been opened up a bit over the previous model and offers somewhat broader tuning.

These changes may seem small, but they make the Ranger AR-3500 far more pleasant to use. The ANL and noise-blanker circuits are especially welcome, as is the change to two banks of switches to move up and down frequency.

Still the Same

The areas that have not changed are still the same ones which we noted last year. They are:

There's no knob for the VFO. QSYing is button-controlled. To move up 10 Hz, you must press the far button on the right ten times. No automatic mode is implemented after several seconds, as is commonly done with other momentary-contact devices in the electronics world.

The CW mode is still strangely implemented. To use it, you have to insert the key, and key the mike while you're transmitting. It's an interesting two-handed exercise. It also indicates that the developers of this rig considered it primarily for mobile voice operation.

The amber LED display washes out in strong light. This is also true of the LEDs for the separate receive and transmit signal strength indicators.

Scan mode is only activated with the squelch in a high position. It takes a lot of signal to overcome the squelch, which works in any mode.

If you want the convenience of using the mike instead of the up-down switches, you must purchase an up-down microphone. You must also purchase a CW board if you wish to use the CW interface correctly. The third option you must purchase as an added-cost item is a speech processor board. These features are usually standard parts of a $600–$700 transceiver.

Memory storage is only partially battery-backed. Memory is retained as long as 13.8 volts DC is supplied to the rig, provided you remember not to turn the memory reset switch off. If you turn it off, memory goes away, even with the 13.8 volts DC input. This also means that if you move the rig, for whatever reason, there is no memory storage. However, we suspect in later versions of the AR-3500, the problem will be fixed.

Conclusions

So, the final verdict on the Ranger AR-3500? Despite the above shortcomings, it's an excellent rig. With 100 Watts and a fairly convenient size, we were able to work from New England to the Midwest reliably and with less than optimum band conditions. The extra 6.02 dB of power more than makes up for any shortcomings.

Also, you can set a repeater offset in memory and operate in split mode so that you can operate 10 meter repeater mode without making any changes, as is the case with other models on the market.

Finally, signal reports and audio reports were consistently excellent with clean, communications-quality audio reported just about every time.

And, last but not least, the price. The suggeted retail on the AR3500 has come down dramatically—from $600 to $350—to make it truly competitive with the other popular 10m mobile rigs on the market today.

Given all the plusses, the AR-3500 is worth a look by the serious 10 meter operator.

The Net/ROM-NordLink Question

A case of software piracy?

by Neil Shapiro WB2KQI

Editor's Preface—As digital technology finds a larger place in amateur radio, the same complex legal and ethical problems in the computer industry are bound to crop up. This article focusses on one such issue—alleged software piracy—that has hit the amateur packet radio community.

The conflict started between two groups: Software 2000, a software development company in the US; and NordLink, an amateur packet radio club in Germany. Software 2000 developed a program, called Net/ROM, to enhance packet radio data transfer. Shortly thereafter, NordLink came out with a program, called TheNet, that had precisely the same specs—i.e., it performed the same range of tasks in the identical hardware configuration—as Net/ROM, Version 1.3. Software 2000 marketed their program—installed on a ROM chip—for $65. NordLink made their program available free of charge.

Ron Raikes WB8DED, president of Software 2000, soon began to claim that NordLink pirated the Net/ROM software. The author, Neil Shapiro WB2KQI, made his own investigation and presents his findings in this article.

See the sidebar for a brief overview of packet radio.

We want your input on this important issue. Send your correspondence in reference to "Net/ROM-NordLink Question."

. . . de Bryan NS1B

The packet radio community is now embroiled in a controversy that could affect the rest of amateur radio. On the high level, the problem focusses on principles of copyright and computer law; on the grass-roots level, it boils down to ethics and community action.

Net/ROM

Ron Raikes WB8DED, founder and owner of Software 2000, began marketing Net/ROM nodes in May 1987. Raikes began beta testing (i.e. field testing) the chip in 1986. The ROM chip he supplied plugs into many popular TNC-2 compatible terminal node controllers, such as AEA's PK-80, and MFJ's 1270/74s. The chip's instructions turn a Net/ROM-equipped TNC into in a Net/ROM node station. Other hams using factory-delivered TNCs can call into a Net/ROM node near them, often with just a 2 meter handheld or other low power transceiver.

Net/ROM is a form of extra intelligence that automates packet data routing. A station so equipped transmits a beacon with its call and a library of other Net/ROM-equipped stations it can link to. A Net/ROM station also listens to the call for the beacons of other Net/ROM stations and automatically records the information in these beacons. From this initial information, Net/ROM nodes automatically configure possible routes of linked Net/ROM nodes for packets to travel. The end result is that users transmitting a packet need only specify the destination—Net/ROM nodes take care of all the routing! With this system, convenient and low-power long-distance communications are possible, and are becoming more routine.

Raikes' product is stored on a ROM chip. Just as a computer program exists on a floppy disk or a cassette tape, it exists within a ROM chip. It helps to think of a ROM program as existing in a protective hard shell.

Too Big a Byte?

In computers, it's pretty much a given that any breakthrough product will be quickly followed by similar products, as programmers see what is possible and begin to develop their own ideas. At first, it seemed just a happy demonstration of such a development when German ham Hans George Giese DF2AU released his TheNet ROMs. His program did exactly the same thing as Ron's Net/ROM program, with the addition of two commands. All other commands and operations appeared identical. Hans soon put into the public domain his TheNet source code (the program in the form of the language it was written in). Public domain software is free for the taking. TheNet nodes quickly began to appear.

Net/ROM nodes continued to appear, but much more slowly. Still, it came as a shock to many people when Ron suddenly accused the people at TheNet of stealing his program.

How Cloned?

Think for a moment about the idea of cloned computers. Dozens of computer manufacturers—Kaypro, Tandy, NEC, Leading Edge, Standard, Franklin, etc.—produce models that all appear to be exact copies of IBM computer systems in what they do. IBM may not be happy about these clones, but they don't often make accusations of theft. What moves Raikes then to claim theft over a single ROM program, when IBM doesn't complain about a whole cloned computer system?

The answer lies in how the product was cloned. There are two principal ways to clone hardware and software—independent development and reverse-engineering. To understand how they differ, you must understand the meaning of configuration and specification. Configuration is the way a computer, or program, performs a given spec. The spec is the range of functions a product can perform given a particular user interface. Often, the spec of a product is called its "look and feel." There are often many configurations that can carry out the same spec. For an analogy, 1 + 2 + 3, 2 + 2 + 2, and 1 + 1 + 4—three different summing groups—all give the same sum of 6.

In the case of independent development, a developer notes the specifications of a product he wants to clone. He then puts together a development group of programmers and engineers who are "untainted," that is, they have no knowledge of the inner workings of the product to be cloned. In hardware and software development, there are a vast number of ways to design a product to meet the same specifications. There's virtually no chance that an independent development team will come up with the same configurations as that in the clone. (There are other "look and feel" issues which can complicate legalities even further, but the preceding is enough background to understand the issue facing us in ham radio today). Independent development is a legal approach, the one performed by the PC clone manufacturers.

To "reverse-engineer" means to copy part or all of the original product configuration. In the case of software, this means to simply look at the program or mechanically copy it onto your own distribution device, such as a floppy disk or ROM. If the original product is copywrited, this is strictly illegal. It is still illegal if the clone is a modification of the copywrited original product. The point is that it is illegal to use the original product's configuration in any way, even as a base for a new program.

Back To Net/ROM

Ron Raikes accuses Hans Giese DF2AU of reverse-engineering his product. He first sought legal counsel, but the cost of an international copyright infringement lawsuit against a group in Germany (Hans Giese's NordLink Group) would be a crushing financial blow to a small development firm like Software 2000. Ron then brought his story to fellow amateurs, which sparked a raging debate, especially in the Hamnet forum of CompuServe, an on-line information service.

THE INVESTIGATION

Why Look Into It?

Ham radio is becoming more and more computerized. Contemporary PLL rigs have

a large digital component. There are many, many software programs on disk and cartridge for your ham shack. The future of ham radio is very much tied to the future of computing. A great deal of the stuff that's produced is public domain software, but much of it, especially the more user-friendly software, is commercially developed. If the developers see that they cannot trust the ham radio community, they may deal themselves out of our market. This, in addition to amateur radio's tradition of ethics and self-policing.

Interview With DF2AU

The first step is to determine whether or not the TheNet chip was developed by independent development or by reverse-engineering.

In a telephone interview, Giese stated that he felt forced to make a clone version of Net/ROM because no source code was supplied with the product, and there were some bugs in the first version. Using an analogy, Hans explained: "You have a radio which has spurious emissions. It came without a circuit diagram. You make such a diagram, and say this is it, this is how to repair the radio."

Hans appeared to waffle on the question of whether or not he disassembled the Net/ROM chip. At first he denied having copied Ron's program by looking at the ROM with a disassembler, one of the tools of software programmers. "We did a new source code in C and made it available; it was not disassembly." Later in our interview, however, Hans said, "I disassembled some part of it." When I repeated that to him for clarification, he considered for a long moment, and then reiterated that disassembly was not part of the process. This ambiguity may or may not be due to the language difference.

After I commented on the extreme similarity of the two ROMs, Giese continued, "If he's (Ron Raikes) going to charge sixty-five bucks for a ROM, he has to live with being cloned. Let's not call it revenge. Let's say that I am an angry consumer. Normally, we would have made TheNet differently, but for Ron's high-nosed attitude."

Raikes' "high-nosed attitude," according to Giese, is his refusal to release the source code for Net/ROM when it was first marketed. Yet, bear in mind that it's unusal for a company to release the source code for one of their copywrited products, for the obvious reason that it leaves the product open for bootlegging.

Government, Business Stance

I spoke to Ralph Haller, the FCC's Chief of Rules and Regulations. He was aware of the controversy, but maintained that the FCC is unable to act without a court ruling. I then turned to the Tucson Amateur Packet Radio (TAPR) organization for guidance. The present head of TAPR, Andrew Freeborn N0CCZ, said, "I encourage the FCC to resolve it. The only way we as an organization can come out and say anything would be because of a lawsuit." They will not investigate because they will not pull their own programmers from development work on other projects. Andy explained that TAPR is not a big organization, but just a handful of people employed full-time in development.

Who Can Act?

Clearly, investigation had to go on at the individual level, and it has. In January 1989, Thomas Allen WA6IGY, an experienced C programmer, compared copies of the Net/ROM and TheNet source code. Allen obtained the Net/ROM source code from Ron Raikes, and a copy of the TheNet source code. He created a cross-reference table of routine names and file names in each program listing. He then compared the two source codes with the following results, quoted with his permission:

"There are 234 Net/ROM routines in Version 1.3. Of. . .232 routines in Net/ROM, all are duplicated in TheNet with identical numbers and types of passed parameters. In every TheNet C function, an identical number and type of auto variable are allocated in the stack in the same order as they are in the corresponding Net/ROM routine." After many such examples, Tom reported: "It is my conclusion. . .that TheNet is not an original development, but rather a direct copy of Net/ROM . . ."

Some people have questioned whether or not the source code Ron has been handing out to people is the real source code. This was easy enough to verify, which Eric Williams WD6CMU did. Eric keyed in the Net/ROM source code obtained from Raikes and successfully compiled it into a Version 1.3 chip.

Further Investigation

I then called on two independent computer consultants, experts in the C language, to verify or dispute Tom's claims. Each consultant was sent both TheNet and Net/ROM source code and a copy of Tom Allen's report. Neither is a ham radio operator.

Both independently arrived at the same conclusion: Tom Allen's report is correct in detail and in its conclusion.

One of the consultants, Jerry Whitnell (President of BC Software), said: "The reasons I agree with Tom are that if you look at both sources with an eye toward what kind of code a compiler would generate, you would have to conclude they are the same. . . . If they were developed separately, even from the same definition, I would expect to see a lot more differences than I do." The source codes varied only by some variable names.

The other consultant, Phil Reed, an internal computer consultant for Clark Equipment, stated: ". . .It is impossible for me to believe that two people could come up with the same routines through this much stuff. . ."

What To Do?

Amateur radio is self-policing; that's always been our credo and to our credit. In the absence of an expensive lawsuit, it must be up to each individual ham to examine the evidence and to draw their own conclusions.

We spoke to one ham, Tadd Torborg KA2DEW, who runs about 100 TheNet nodes in the New England region. He told us he would soon be in contact with Raikes. If Ron can show him proof that the printed source code from Software 2000, which appears identical to TheNet's alleged copy, actually produces a production Net/ROM chip, he will pull down all of his TheNet nodes. He may or may not bring them up as Net/ROMs. There are many alternatives. This is the sort of action that all affected hams should be considering.

There will probably not be a formal court case because of the vast expense of such an undertaking. In this case, the ham radio community itself must serve as its own court. Are we up to abiding by our own verdict? 73

Bits of Background

There are three essential hardware ingredients to a packet station—a transceiver, a microcomputer, and a data controller that interfaces (i.e. patches together) the first two. Data controllers are responsible for converting the information that flows between the micro and the rig to forms each can accept. A telephone modem serves essentially the same function as a data controller. Data controllers require some intelligence to perform their functions, and so are computers in their own right. Data controllers dedicated to modulating/demodulating just packet radio data are most often called Terminal Node Controllers (TNCs).

Like all computers, TNCs require "software"—one or more computer programs—to know what to "do." These are instruction that are stored on a "chip" (IC). Since these programs are vital to the TNC operation, and typically never need alteration, they are stored on a Read Only Memory (ROM) chip. A ROM chip is an IC from which you can "read" (draw from) the information stored within, but to which you cannot easily "write" (add/alter information).

One of the many unique functions of packet radio is its ability for different packet stations to time-share a frequency. It can do this successfully because a packet radio system monitors a channel and transmits only when it senses a clear channel. Packet stations that act as relays for packet signals are called digipeaters (digis). They act like repeaters, except that they operate on only one channel (simplex). When a packet to be relayed arrives at the digipeater, the digi stores the packet into a buffer and keeps it there until the digi doesn't detect any activity on the channel. At that point, it transmits the packet.

This is a neat concept in itself, for you could theoretically send a packet anywhere, provided there are digis en route. A packeteer, however, still had to know the route and specify all the intermediate digi addresses in their correct order when sending a packet to a destination address. This can be very cumbersome for long-haul transmissions. Fortunately, much of the routing has been automated through systems such as Net/ROM, which you can read about further in the article. . . .

. . .de NS1B

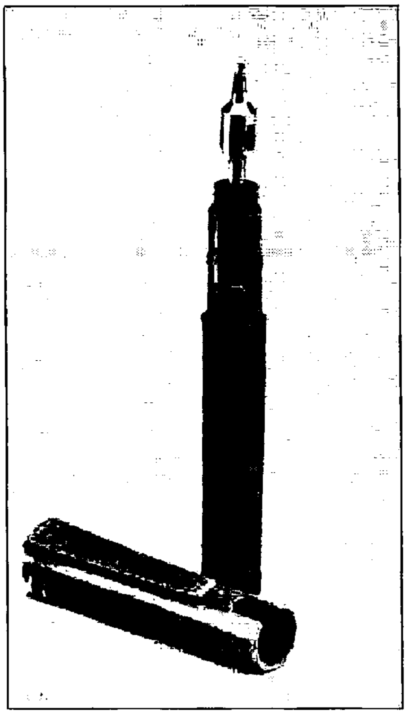
Number 10 on your Feedback card

73 Review *by Larry R. Antonuk WB9RRT*

GC-Thorsen
1801 Morgan Street
Rockford IL 61102
(815) 968-9661
Price Class: $50

Portasol Butane Soldering Pencil

An easy-to-use version of a much-abused tool.



The most abused tool in every technician's toolbox has certainly got to be the soldering iron. Normally crammed in the bottom drawer, sporting a frayed cord and a worn-out tip, the lowly soldering iron also takes a great amount of verbal abuse. It takes too long to heat up. The tip is too large/small/etc. Not enough wattage. Always rolls off the table. The list goes on and on.

It's no surprise, then, that most hobbyists (and some professionals) show a definite lack of interest when buying a new soldering pencil. Most irons are bought without much careful shopping or consideration, and the users tend to pay the price in frustration. It's not uncommon to see someone using a $2.99 iron on a $2500 ham rig, and then wondering why those cheap PC board traces keep peeling up.

New on the market for 1989 is a product destined to change all of that—a butane version of our old friend. The Portasol butane soldering pencil system is efficient, powerful, versatile, and even fun to use. The Portasol is about the size of a cigar tube, and comes with a pocket clip on the cap. The cap pulls off, and contains a flint-type striker for lighting the unit. The deluxe version includes a plastic carrying case and an assortment of tips. In addition to one large and one small tip, the kit comes with a torch tip and a heat-shrink tubing tip. The torch, although small, is useful for heating and bending small diameter rod, and works quite well for soldering connectors on Heliax™ cable. The heat-shrink tip is a flameless device that works wonders on tubing (the heat gun could become a thing of the past). A tip-cleaning sponge and an iron holder (that "third hand") round out the kit.

Soldering with Gas

The first thing that you'll notice after you "fire up" the iron is that its novelty makes using this tool enjoyable, even fun. The advantages of soldering with gas—not having to wait long before soldering, not needing to find an outlet, or get tangled in the cord—all make this a very friendly tool.

Once lit with the built-in igniter, the Portasol comes up to solder-melting temperature in about thirty seconds. The valve on the base of the unit acts as a heat control, and a sliding button on the side of the unit acts as an on-off control. Once the tip is up to heat, the iron can be set to a lower "idling" temperature. At this setting, you can expect about two hours of burn time. The tank is contained in the handle of the unit, and can be refilled with the type of canister sold at most drugstores (used for refilling cigarette lighters). These canisters were available in my area for about two dollars, and I estimate that you can get ten to fifteen charges per canister.

The small tip works well on PC board repair, but how hot does the big tip get? The only answer to that lies in the answer to the first question out of every radio man's mouth, "Yeah, but does it solder PL-259s??" It sure does, and has enough capacity to do the job well. It fell short only one occasion, which happened to be outdoors on a windy New Hampshire winter day. (We needed a good excuse to come inside, anyway.)

The Portasol Butane soldering system comes as a kit for $50, or as a one-tip iron for $30. Considering that most professional bench irons start at fifty dollars, the Portasol is quite a bargain. As a matter of fact, if you do only intermittent bench soldering, the Portasol could easily replace a bench iron.

The Portasol is built in Ireland and is distributed in the US by GC-Thorsen. The basic unit, less spare tips and carrying case, is also available from Radio Shack. ■

The 220 MHz DMOS Linear Amplifier Project

Follow-up to January's 220 MHz transverter project.

by Robert E. Bloom W6YUY

For those dedicated home-brewers who have just gotten warmed up on the transverter project (Jan. '89 *73*), here is another item to apply the iron to: the DMOS linear power amplifier.

Chassis

This amp is constructed on a 10" x 3¾" x ⅝" radiating fin heat sink. The linear output of this amplifier exceeds 60 Watts RMS on CW power. The heat sink is somewhat larger than required, and runs quite cool. The amplifier is contained in an attached box made from double-sided material 1-½" deep. About a third of the box is empty. If you plan to make this state-of-the-art, cool linear amplifier, you may want to use a different heat sink.

Basic Circuit Description

The linear power amplifier package consists of two stages: a poly core F-1202, 20 Watt MOS power driver and a M/A COM PHI DU-1260T UMOS 60 Watt amplifier. These are both 12 volt transistors, but you can operate them at much higher voltages if you observe the specifications. Both of these companies manufacture a variety of units, from 2 Watts to 200 Watts, in frequencies to 1.4 GHz. See the sidebar for a description of MOS power.

DMOS Power Amplifier

The only similarity to printed circuitry in the amplifier unit was the removal of four short ¼" wide strips of foil at the input and output of the two DMOS transistors. It probably was not necessary to do it this way but I wanted the strips to look inductive, such as in an L-network. I didn't know at the time that all but the input circuit of the driver was going to be heavily loaded with Unelco or Underwood low-inductive capacitors. The placement of these capacitors is responsible for the amplifier's outstanding purity and stability. The relatively narrow bandwidth or selectivity of a tuned design compared to a broadbanded design, along with the purity of the linear RF output, made output filters unnecessary.

Despite several tuned stages preceding the UMOS amplifier, I thought it prudent to include a seven-segment filter at the input of the amplifier driver stage. Why not put it at the output? This is because silver mica "dog bone" capacitors will not handle the 60 Watts of RF current normally available. If you have the larger, more specialized capacitors required, you may wish to put them in your unit.

It's best to lay out the filter in a zigzag fashion so the inductors don't couple with each other. The best place for the filter is along the side panel, allowing space between the input gate of the transistor and the BNC input coaxial bulkhead connector. If you want the filter in the output end with higher current capacitors, you will probably have to compromise space with the antenna connector and the receiver BNC connector on the wall at that end of the unit.

Strip Line Technique

Small strips of single-sided PC board material are used as input and output inductors to the power FETs. The small strips of PC material not only make the inductance for the L-network, but also allow for the placement of non-inductive capacitors and other components.

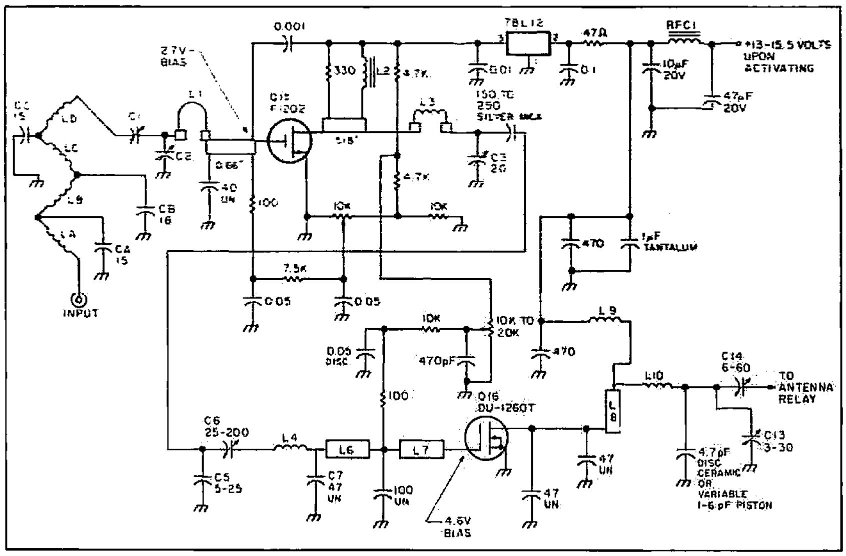


Figure 1. Schematic for the 220 to 225 MHz D-MOSFET linear power amplifier.

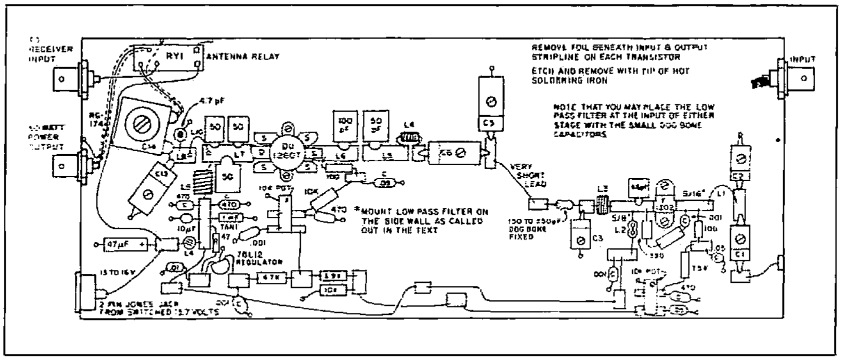


Figure 2. Parts placement for the D-MOSFET linear power amplifier.

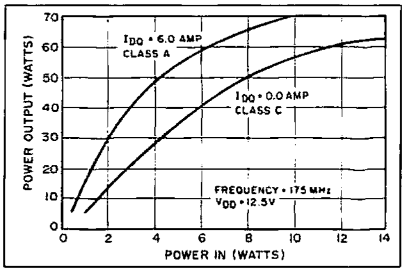


Figure 3. Input power to output power chart for the DU1260-T in the linear power amplifier.

Class A or AB bias is applied through a resistor to the gates of the driver and final transistors. Each stage has its own bias level pot. You will notice that all B+ lines are well filtered as a precaution against any unwanted signals coming in on the voltage line. This is so throughout the entire transverter design, so get a good supply of 0.001 disc ceramic capacitors.

As a last precaution, check each RF stage of the transmitter for proper operation in serial progression, keeping all drain voltages disconnected until the preceding stage is working properly. Use a Bird wattmeter or other RF instrument with a small 50Ω dummy load to assure 3.5 Watts output from the transverter proper. Follow the same procedure, using a temporary cable from the output of the amplifier driver stage. Make sure that, before connecting drain voltage to any of the three MOS power transistors, the three bias pots are set to minimum voltage. Eventually, the bias voltages will be close to 6.5 V to Q-14 (DV-1205S), 2.7 V to Q-15 (F-1202), and 4.6 V to the Q-16 (DU-1260). The final transistor puts out 60 Watts plus. The power amplifier can operate very safely with 13.5 to 20 volts at the drain with higher output power from the higher voltage.

The bias source voltage is regulated with a small 12 volt regulator. The purpose here is to retain the set bias voltage should you wish to master-power the system with increased voltage. The bias voltage sets the amount of drain current; an increase in drain voltage does not affect the drain current setting, but you will increase the output power by virtue of the increased voltage.

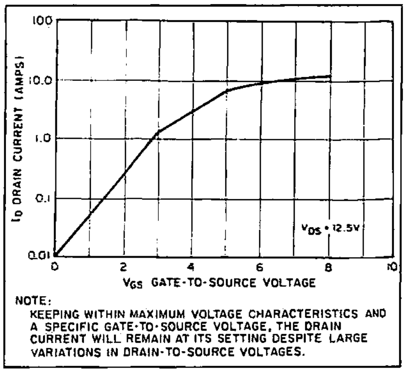


Figure 4. DU-1260T transfer characteristics.

Circuit Comments

The physical size of the linear power MOSFET amplifier is mainly related to the size of the heat sink. The one I prefer has four fins on each edge. I suggest that you write to *American Electronics Co., 173 E. Broadway, Greenwood, IN 46142* and ask for their parts catalog, which costs $2.

I placed the low-pass filter for the DMOS power amplifier at the driver input. The small dog bone capacitors safely handle the RF current at this point. Though I could have placed it at the input to the final DU-1260T stage, I reasoned that any garbage most likely would have been generated ahead of these stages. The number one contender is the 2N3866 stage, but it appears clean. It is better

220 to 225 MHz D-MOSFET Linear Amplifier

Parts List

Q-1	F-1202 20 Watt gold metalized power FET transistor, single-ended from Polycore RF Devices, 1107 Tourmaline Drive, Newbury Park CA 91320.
Q-2	DU-1260T N-Channel MOSpower FET from M/A COM PHI, Inc., 1742 Crenshaw Blvd., Torrance CA 90501.
1	Jones 2 prong male and female bulkhead for source voltage Input.
1	8 pin mike type male bulkhead jack from Philmore Mfg. Co., Inc., Inwood NY 11696.
1	8 pin mike type female plug Philmore No. 1700, $2.95 list. Both plug and jack also available from Radio Shack, Henry Radio, and Hosfelt Electronics (female) P/N MC8P, $2.50. Male chassis bulkhead P/N 8PMCS.
1	Cynch Barrier block for input power (Hosfelt); Heat Sink (Hosfelt and Pete Smith)
S-1	Miniature triple-pole single-throw Switch
RL-2	Control Relay single-pole double-throw 12 volt 40 mA coil minimum, coil resistance 250ΩRL-3Tx Plus Power Control Relay 100–270Ω field coil, 4 sets of double-throw contacts set parallel to handle 10 amperes
RL-1	12 volt Antenna Relay single-pole double-throw, with quality contacts and reasonable low capacity between contacts; Field Coil between 100–700Ω Pad Gate and Drain Pads for F-1202. 1/16" Single-sided PC material 1/4" wide x 0.66" long and 1/4" x 5/8", respectively
L-6, L-7, L-8	PC Material as above, ¼" wide ⅝", ⅜" and 0.66", respectively.
L-A, L-D	Low-pass Filter Coils 3/16" inside diameter 3 turns
L-B, L-C	Low-pass Filter Coils 3/16" inside diameter 4 turns
CA, CC	Dipped Silver Mica dog-bone capacitors with 500 V test rating 15 pF
CB	As above, 18 pF
RFC-1	3 turns on 6 hole Ferrite Bead FB-43-5111 Amidon
L-1	¾" long #18 Tinned bent into a hairpin ⅓" diameter
L-2	4 turns on BN-43-2402 Amidon Balun Core
L-3	3 turns #20 Tinned 3/16" ID spaced one wire diameter
L-4	5 turns #20 Enameled 5/32" ID Close Wound
L-5	None
L-9	5 turns #20 Enameled 5/32" ID Close Wound
L-10	1 full turn #16 or 18 Enameled ¼" ID
C-1, C-5	2–25 or 3–30 pF 404 series Small Arco Compression Trimmers
C-2	10–80 pF 404 series Small Arco Compression Trimmers
C-3	3–20 pF 404 series Small Arco Compression Trimmers
C-6	25–200 404 series Small Arco Compression Trimmers
C-7, C-9, C-10, C-11	Underwood or Unelco 47 or 51 pF noninductive capacitors
C-5	As above, but 40 pF
C-8	As above, but 100 pF
C-12	4.7 Disk Ceramic or 1–7 pF piston capacitor
C-13	1" long 420 series 2–3 Arco Compression capacitors
C-14	1" square (two plates) Arco 300M series 6–60 pF variable compression capacitors

to have the filter at a low-level stage than to amplify signals and create a bigger filtering job. As a rule, MOSFET linear amplifiers run far cleaner than bipolar types simply because at elevated signal levels, the bipolar transistor is basically a non-linear device.

For RF amplification, use the following guide to set up the DV-1205S V-MOSFET stage Q-14 in the main transverter unit. The level of drain current and ultimate power output of the stage 4 volts sets up a drain current of 200 mA, while 6 volts sets up 400 mA, and 7 volts sets up 600 mA. If you don't get an increase in power output with increased drain current, you don't have enough driving power to increase the power output of the device. It isn't economical to increase the drain current further. Since this project has three MOSFET linear amplifier stages, set the output levels for only what you require. On the other hand, if the drive is much greater than you need, don't worry about blowing the FETs, since you can't hurt them by overdriving a little.

Test Equipment

In order to align and test the devices described in this article, you need the following test equipment.

1. A stable signal generator or calibrated oscillator and 50Ω adjustable attenuator covering the appropriate RF range.
2. A VHF-range RF vacuum tube voltmeter or a good DC vacuum tube voltmeter with UHF RF probe. (Solid state is fine, too.)
3. An electronic frequency counter covering the appropriate frequency range.
4. A VHF grid dip meter to check coil resonance. (Not absolutely necessary if you follow coil winding data closely, but it can be a real aid.)
5. Capacity bridge to confirm small values of capacity marked, and to set a given capacity in a test circuit. (See *Ham Radio*, March 1980, page 54.)
6. A Bird Model 43 or other power measuring device, and a 50Ω load (termination).
7. A multi-range VOM. It must be capable of reading current to 10 amperes.

Where To Find Component Parts at Reasonable Prices

In this project you will use quantities of miniature plated capacitors, various sizes of compression capacitors, disc ceramic variables and fixed capacitors, and dipped silver micas (dog bone) components. Fixed disc ceramic of 0.001 μF are sprayed around the source voltage lines as bypasses and as both coupling and decoupling circuits. In circuits requiring a degree of stability, use silver mica caps. Johnson 2–12 pF, usually 8 plates total, are used in stable RF circuits. These plated and small, high quality Argo compression types resonate coils.

All powdered iron and ferrite toroidal cores and baluns are available from Amidon Associates. You can buy the 8-pin DIN plug from Kenwood. Get two. The price ranges from $2 to $2.50 each. I bought my crystal from *Jan Crystals, 2400 Crystal Drive, Fort Myers, Florida 33906-9989.* Order series resonance 0.001 accuracy and enclose a schematic diagram of the oscillator circuit.

MHz Electronics Inc., 3802 N. 27th Ave., Phoenix, Arizona 85017 advertises in most ham publications. They also have crystals, transistors, and Unelco non-inductive capacitors for the power amplifier. (Send for a catalog.) Another excellent source for dipped silver mica capacitors, miniature variables, JFETs (15¢), 4067 (25¢) relays, and the small heat sink 2N3866 is *Hosfelt Electronics, Inc., 2610 Sunset Blvd., Steubenville, Ohio 43952.* The 8-pin mike type plug and jack are available from *Henry Radio* and *Radio Shack.*

You will notice full use of tuning capacitors. This could add up to a nice piece of change. Many of the stages in the receiver could be tuned temporarily with a good quality fixed capacitor. Remove the capacitor and measure a digital capacitance bridge, substituting the capacitor with a good quality dipped silver mica. Then compress or expand the coils on the toroidal core until resonance is re-established. This is a mildly complex substitution I have seen described in many publications.

Parts are also available at ham swap meets, and I have some items at very reasonable prices. If you have questions or comments, feel free to write me. Enclose an SASE for a response. Upon completing this project (I wish to emphasize taking your time, step by step), the gratification and pride you will feel cannot be expressed on paper.

Look for the 6 meter transverter project in a subsequent issue of *73* magazine. ■

What Is MOS-Power?

MOS-power FET transistors were developed by the Siliconix Transistor Manufacturing Company more than a decade ago. MOSFET transistors differ from bipolar transistors. They have a closer relationship to the vacuum tube, but are still different. You might ask, "Since they have been with us for over a decade, why haven't we heard more about them?" The answer is twofold: (1) Low-power VMOS-FETs are widely used in industrial pulse applications, and (2) The manufacturing industry of these devices is still working through the maze of problems relating to high-level production with power FETs.

We do have an early generation of CMOS transistors and integrated circuit chips. Siliconix, the originator of VMOS power transistors, sold its power MOS division to the M/A COM PHI Corporation located in Torrance, California. Today they no longer produce power FETs.

VMOS and UMOS FETs as described in this project are N-Channel MOS power FETs operating in an enhancement mode. The "V" in VMOS (vertical metal oxide semiconductor field effect transistor) relates to the "V" structure of the gate, where the current has a vertical flow across the short dimension of the chip. The "U" in UMOS is a later truncation of the "V" structure of the chip that allows the transistor to produce higher levels of output power plus a very consistent level of gain over the frequency range.

VMOS or MOS power FETs are high impedance devices (possibly higher than that of the vacuum tube). At low frequencies, they are capacitive devices, rather than inductive, as compared to a bipolar device which is low impedance, and both input and output look inductive. In contrast, the dynamic impedance at the high frequencies is low, but several times higher than the BPT. The bipolar device has a reputation of "thermal runaway." The hotter it gets, the more current it draws; the more current it draws, the hotter it gets, until it destroys itself. The MOS power device has an opposite effect. The hotter it gets, the less current it draws, until it shuts itself off.

Because of the nonlinear gain of a bipolar device (having high beta, or gain at low frequencies) tapering off at the higher frequencies, the beta reaches a level of unity or the cut-off frequency. Therefore, bipolar power transistors are catagorized according to their specific frequency ranges of operation. Should lower frequencies be induced on the source power line, use special circuitry in the power source to prevent the transistor from oscillating and burning up as a result of the higher gain at the lower frequency.

VMOS, on the other hand, have a very flat frequency gain. Usually this response is better than ±1 dB across the range, including the audio frequencies. It is common to see a 175 MHz device used in a broadband 2–30 MHz amplifier, for example. A significant deficiency of the bipolar device is immediately noted as soon as you get out of the small signal level of operation. The bipolar transistor is basically a Class C device and exceptionally nonlinear. To use a bipolar power device in the linear mode, the transistor must be bulldozer-style biased, with a silicon diode somewhere in the voltage divider chain to hold the bias level. Also, the diode must be in contact with the transistor, so that as the transistor heats up and the linear bias point level drifts, the diode will also heat up and reestablish the linear bias point.

In comparison, a MOS-power transistor with its exceedingly high resistance gate circuit can be positively or negatively biased for any class of operation: A, B, C, D, or E, unaffected by heat. In that the gate circuit draws virtually zero current, the impedance of the bias supply is immaterial and will stay exactly where it is originally set.

Most manufacturers state that you cannot destroy a VMOS device by overdriving. Some will not admit to sudden failure in a new design, such as a transient which can punch a hole through the very thin barrier between the gate and source. However, the device will operate safely with infinite SWR to either its input or output—an exceptional characteristic you can be very happy about. All of the manufacturers test their devices with a 20:1 VSWR mismatch and 30:1 is called out on the specification sheet. Sounds like April First!

Maximum junction temperature is specified at 200°C (392°F). Typical power gain of the device is 10 dB across the whole frequency range. I have seen devices specified as low as 7 dB and as high as 14 dB to 1.4 GHz. With these impressive advantages over the bipolar, we can visualize a faster demise for the bipolar transistor than even that of the vacuum tube.

73 Review by Bill Clarke WA4BLC

The MFJ Differential-T Antenna Tuner

MFJ Enterprises, Inc.
PO Box 494
Miss. State, MS 39762
601-323-5869
800-647-1800
Price Class: $240

A simpler, surer tuner.

Over the years, various configurations have appeared on the market and in magazine construction articles. Each was alleged to be an improvement over all the others. Some may have been, but the majority just plain worked, at least after a fashion.

Antenna tuners can be thought of as variable transformers that compensate for differences between your antenna's actual RF impedance and the impedance your transceiver would like to see at its coax connector. They are the great equalizers in the game of reducing the SWR seen at the rig.

In manual tuners, the operator must make manual adjustments to controls on the antenna tuner for it to do its job. Generally, tuner adjustment consists of selecting an appropriate inductance from a multi-position switch and adjusting two variable capacitors until the SWR indication at the transmitter is at 1:1 (or as low as you can get it). SWR is indicated by a meter that must be switched between forward and reflected power to obtain comparative readings.

New Version

A few months ago, MFJ introduced the Model 986 Differential-T Antenna Tuner. It is a 3 kW unit, providing very simplified (only two controls) broadband tuning and incorporates all the RF output metering you'll usually ever need.

This tuner uses a single differential variable capacitor and a roller inductor in a T-Network circuit. The usual tuner configuration consists of two variable capacitors and a switch-selected inductor in a Pi-network. The first obvious improvement on this tuner is that there is one less variable control for the operator to adjust. Merely crank the variable inductor and turn the capacitor control until the SWR is maximally dipped.

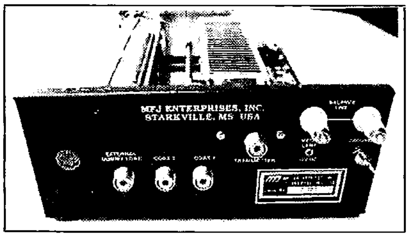


Photo B. Rear panel provides feedline, ground, and 12 volt DC connectors.

A cross-needle SWR meter is built into the unit, giving simultaneous readings of forward and reflected power. A novel inclusion is a peak reading meter circuit for SSB power output. This is a feature many SSB operators want. Before now, that meant the purchase of a separate meter costing as much as $300.

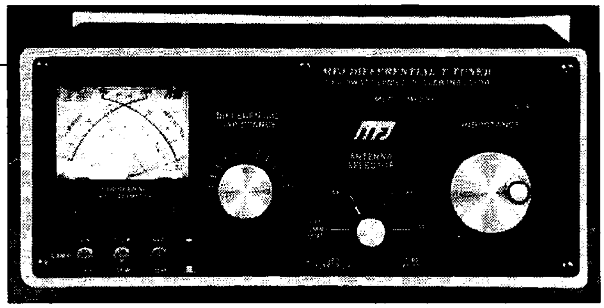


Photo A. Front view of the MFJ-986 showing the two tuning controls, antenna selector switch, and the cross-needle meter.

Features

The Model 986 has:

- Continuous 3 kW from 1.8 through 30 MHz.
- A dual-range (200/2000 Watts) back-lighted cross-needle meter providing SWR, power, and peak reading functions.
- A 6-position ceramic switch allows selection between two coax feeds, a balanced line, or a dummy position (which could be used for a bypassed antenna or dummy load).
- An internal balun for balanced feedlines.
- Small size (10.75″ x 4.5″ x 15.0″).

Inside the Model 986

Before operating the MFJ-986, I removed the covers. Inside I found a large roller inductor with 62 turns on it, with an attached belt-driven turns counter. The capacitor is of high quality construction with adequate spacing for all legal ham output power (and then some). The antenna switch is ceramic and the balun is constructed of two stacked toroids with windings positioned in a manner that should preclude any flash-over problems. Soldering and mechanical work shows itself well, with no obvious defects or poor quality workmanship noted.

Use

The instruction manual includes a small chart for preliminary settings for each band. Using the recommended settings, I tuned my 75 meter loop for 3947 kHz. Tuning was done by turning the roller Inductor crank until the counter indicated 046. I then applied a little power and continued inductor adjustment until I located the lowest reflected power indication point. Afterwards I adjusted the capacitor for further reduction. I then fine tuned with these two controls. Total time for the first tuning was nine seconds. I then logged the capacitor setting from its vernier scale and the inductor setting from the inductor's counter. This information is good as a starting point when retuning the same antenna system for the same resonant frequency later on.

I then tuned the same antenna for each ham band. There were no problems and all settings were logged. Using the loop has presented a problem for my other tuner on 10 and 15 meters, but the MFJ-986 tuned it with no problems.

The last operational test was to reset the tuner for each band per my notes based on the previous settings. The unit proved to be very resetable, although some fine tweaking was needed on 75 and 160 meters.

Varied Comments

The turns counter is relative only, but it's completely accurate for logging and resetting. Having the built-in cross-needle forward/reflected meter is a real advantage over other tuners. The peak reading meter is ideal for those of us attempting to run a full gallon.

The antenna selector switch should be self-grounding. As it's set up, feedlines not in use are not grounded.

Due to the design of the differential-T circuit, it is possible to get a low SWR at only one combination of the controls. No more worry about too much inductance.

Highly Recommended

Pricewise, the unit is a bargain. You get a cross-needle meter that includes simultaneous forward/reflected indications and selectable peak reading, an antenna selector switch, and a 3 kW tuner all in one box. Yet the unit sells for over $100 less than its nearest competition, which is the MFJ-989B.

Do I recommend this tuner? Yes! It is economical, solid, and easy to use.

QRP SWR Bridge

This simple project lets you monitor your antenna system's SWR.

by Tony Smith G4FAI

Low power (QRP) operating enjoys an enduring popularity in amateur radio. Much of the equipment is relatively simple to home-brew, and there isn't the need for many of the precautions required when operating at higher power levels.

Opinion on what constitutes low power varies between different countries, and between different operators in those countries. The G-QRP Club's definition of less than 5 Watts input, and the (American) QRP Amateur Radio Club International's maximum of 5 Watts output, are the power levels referred to in this article.

Transmitters need to "see" a specified load, usually 50 to 75 ohms, at their output. Whether the antenna in use is already matched to the required impedance, or whether the match is obtained through an antenna tuning unit (ATU), a standing wave ratio (SWR) bridge lets you monitor and adjust the effect of the load on the transmitter (Figure 1). (Many modern transmitters automatically reduce their output power if the antenna system presents a mismatch.) The bridge is thus a useful device to help obtain optimum performance at all times.

When a transmitter transfers power to a feeder line of the correct impedance, and the feeder terminates at an antenna also presenting the correct impedance, the antenna accepts and radiates all of the power coming to it. When the antenna has the wrong impedance, e.g. because the feeder is not correctly terminated, a portion of the power is reflected back down the feeder in the form of standing waves. The ratio between the forward power and the reflected power is the standing wave ratio, and the function of an SWR bridge is to indicate that ratio at the point where the bridge is located in the feeder line.

The Circuit

The design shown in Figure 2 is a simple unit for QRP operation on all authorized frequencies up to 30 MHz, based on a toroidal transformer T1. The secondary winding of T1 samples a small amount of RF power (both forward and reflected) which is divided by the bridge circuit and rectified by diodes D1 and D2. Forward and reflected readings are obtained simultaneously on the two meters M1 and M2, and the bridge is matched and balanced at the required load impedance by C1 and C2. See Figure 5 for an alternative, less expensive, single meter version. The bridge also measures forward power.

Although it should not be regarded as a laboratory instrument, the bridge is sufficiently accurate for all practical hamming purposes.

The project is housed in an easily constructed wood/hardboard case, partly to keep the cost down and partly to give the builder the satisfaction of creating a completely "home-brewed" unit. If you want to use a metal case, feed-through capacitors C4 and C5 are then unnecessary.

Construction

There are any number of ways to fabricate a case for the bridge. I built my case out of wood, using nails and glue to hold it together. I suggest drilling the holes for the nails, slightly undersize, to keep the wood from splitting. The front panel is secured by panel pins and glue, and the top and rear panels are secured by woodscrews to facilitate access and setting-up.

In the prototype, the nails and panel pins were punched below the surface level of the case and all gaps, holes, and irregularities made good with filler and rubbed down. The case, plus rear panel, was painted inside and out with matt black paint, and the top cover with black gloss. The front and sides were covered with Fablon™ after the meter holes had been cut out.

The holes for the meters were cut by marking the position of the meters on the front panel and drilling a series of small holes round the inside of the circle. The meter holes were then finished off with a half-round file. Exact details and measurements for meter and potentiometer mounting will depend on the particular meters obtained for the project.

You can use virtually any meter having a 100μA linear full-scale deflection (FSD), and these represent the main cost of the project. It's worth getting the best quality possible to ensure a long life in the meter mechanism. Those used in the prototype had a front face size of 60 x 45mm, a panel cut-out of 38mm diameter, and an accuracy of 2.5 percent.

The components are mounted on Veroboard as shown in Figure 3. Matched diodes are required and a simple matching circuit is shown in Figure 4. The circuit board is fitted on spacers inside a small aluminium box with 15mm woodscrews passing through the board, the spacers, the bottom of the box, and the earthing plate, into the floor of the case.

Mount the input and output sockets at the rear of the box, and drill holes in the rear panel of the case to allow access to the sockets. Phono sockets were used in the prototype, as these are frequently used for QRP operation, but any type can be fitted to suit the constructor's needs. Take care when fitting the sockets to ensure that they do not prevent the lid fitting properly on the box. Similarly, make sure the box will fit into the case, leaving room for the lip of the lid between the box and the rear panel.

Route the connections to the meters via feed-through capacitors, C4 and C5, which are intended to be soldered to chassis. As the box is aluminium this presents some difficulty. In the prototype, I drilled holes in the box (making sure the lid was not obstructed) which were marginally smaller than the diameter of the capacitors. I carefully enlarged the holes with the

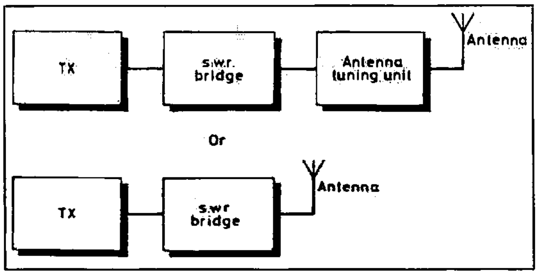


Figure 1. SWR bridge placement—keep the feeder length between the transmitter and bridge as short as possible.

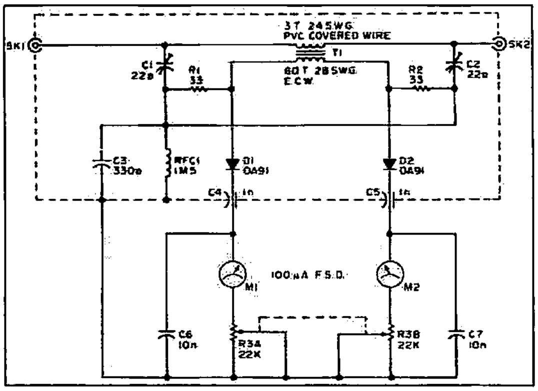


Figure 2. Circuit diagram of the QRP SWR bridge.

tang of a small file until the capacitors could be secured with a press-tight fit and finally secured with a dab of "super-glue." This arrangement has proved quite satisfactory but purists might prefer to solder the capacitors to a small rectangle of tin plate and bolt the assembly to the side of the aluminium box. The wiring-up of the meters and the dual potentiometer should present no difficulty.

Setting-up

Once the unit is assembled, you must balance the bridge. Connect the transmitter to one of the rear sockets via a short length of coaxial cable having the same impedance as the TX output. A further length of the same cable connected to the other socket should be terminated by a non-inductive dummy load of the same impedance. You can make this up from one or more carbon resistors to obtain the resistance and wattage required.

Now apply a radio-frequency (RF) carrier at the highest used frequency. One meter should indicate a high, and the other a low, reading. Adjust the trimmer capacitor on the side of the bridge showing a low reading (reflected power) to obtain the lowest possible reading. Now, reverse the connections to the sockets and make the same adjustment with the trimmer for the second meter. Repeat this procedure once or twice until finally both meters, when indicating reflected power, read zero, and the bridge is then balanced. During this process, adjust the potentiometer so that whichever meter is indicating forward power is set at full-scale deflection.

Calibration—SWR

You can use either meter for forward or reflected power indication, depending on which socket is used for input or output. For SWR readings, both meters are used and that showing forward power needs only to indicate FSD. For reflected power, opinions differ on the need for detailed calibration. The most important marking is at a point exactly halfway across the scale, which represents an SWR of 3:1. Any SWR in excess of that may be detrimental to the transmitter. An SWR of 2:1 or less is acceptable, especially with low power.

Therefore, you need only a center marking to indicate maximum permissible SWR. The aim is to get the reading down to as near to zero as possible.

Calibration—Power

It's easy to get forward power readings since the circuit provides a reasonably uniform indication of RF power, irrespective of frequency, over its range of operation.

Calibration modes, unfortunately, require an external means of measuring RF power for comparison purposes. Those who have access to RF measurement can set the forward meter to FSD when the desired maximum RF power passes through it into a dummy load. Note the setting of the pointer on the control knob by making a mark on the front panel. With the control at this setting, feed successively lower RF powers through the unit and mark the meter scale accordingly.

Operation

The bridge should still be connected to the transmitter. Connect the output to an antenna system.

Apply power and check the meters. Adjust the tuner for minimum SWR (1:1 if possible). Take care that the forward meter reads FSD, but that it isn't pegging against the end-stop, as that can damage the meter.

If you are using an antenna system without a tuner, and the antenna is cut for the frequency for the input signal, you may want to check the bandwidth of your antenna. Do this by checking the SWR at different frequencies across a band. This will often show you how to alter the antenna dimensions for a different resonant frequency.

Leaving the bridge permanently in line lets you monitor the effect of the antenna system on the transmitter output. Bear in mind, however, that a low SWR indication does not necessarily mean an antenna is performing well. A dummy load, for example, presents a near 1:1 SWR through a matching feeder, and yet is virtually non-radiating. Too, it measures SWR only at the point in the feedline where the bridge is located—not at the antenna itself.

An SWR bridge is a valuable part of every radio operator's station. It is a useful tool when constructing antennas and exercises an essential control function when they are in use. Because of its simplicity it is an ideal project for home construction, especially for beginners, and with good quality components it will last for years. QRP operation itself offers enormous scope for home construction and experimentation, and a unit such as this should be an integral part of every QRP station.

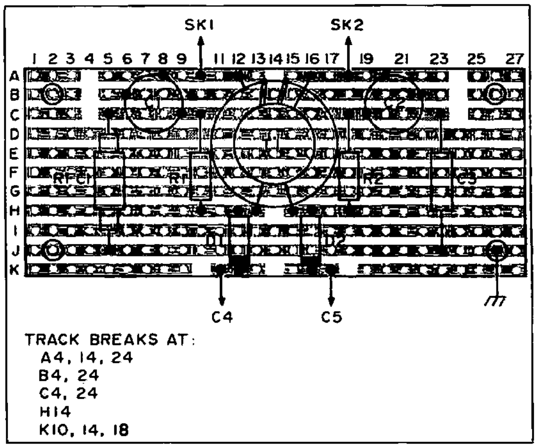


Figure 3. Component locations on the Veroboard. Drill the mounting holes very carefully to avoid damaging the board.

Warning

The unit as described is suitable only for low power operation. The circuit is capable of operation up to about 100 Watts.

Taken from *Practical Wireless*, October 1983.

COMPONENTS

Resistors		
Carbon film ¼W 5%		
33Ω	2	R1,2 (Matched, see text)
Potentiometers		
Dual-ganged		
22kΩ	1	R3
Capacitors		
Ceramic		
10µF	2	C6,7
Feed-through		
1µF	2	C4,5
Polystyrene		
330pF	1	C3
Miniature trimmer		
2-22pF	2	C1,2
Semiconductors		
Diode		
OA91	2	D1,2 (Matched, see text)
Miscellaneous		

Meter 100µA FSD(2); RF Choke 1.5mH (1); Toroidal core T68-2 (1); Veroboard 0.1 inch matrix 24 holes x 10 tracks; Metal box 73 x 51 x25mm; Phono sockets (2); Pointer knob; Enamelled copper wire 28 s.w.g. (1.3m); Insulated wire 24 s.w.g. (100mm).

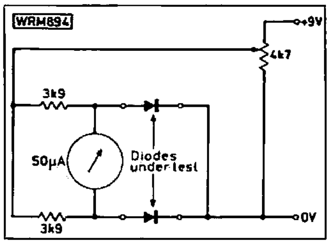


Figure 4. Simple diode matching circuit. Match the two resistors with an ohmmeter. As the voltage is increased by rotating the potentiometer, the meter should not deflect more than 1 µA from its no-current setting. It may be necessary to test several diodes to obtain a matched pair.

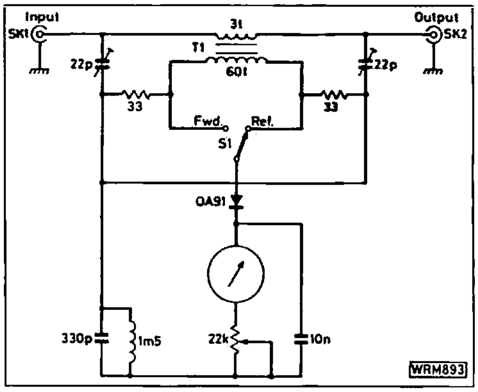


Figure 5. Single meter version of the SWR bridge.

continued from p. 25

Winding a transformer can be tricky when you're trying to get the right wire soldered to the correct circuit board pad. Refer to T4 on Figure 6. Note the dots. These are "phasing" dots. They indicate which wires are on which end of the winding. Numbers 1 and 2 are the ends of one wire, 3 and 4 are the ends of another, and 5 and 6 are the ends of another. Numbers 1, 3, and 5 begin the coil and 2, 4, and 6 are at the other end.

Notice, however that 2, 3, and 6 are connected together and go in one hole in the board. They are all at ground. Thus, there are only 4 connections to the circuit board.

You will probably need to use an ohmmeter to check which wires are continuous after winding the toroid. A simpler way, however is to use different colors of wire. You can use 26 or 30 gauge wire inplace of No. 28 wire. You may mix sizes if you have different colored wire of different sizes. This saves a great deal of time. The wire sizes should not be too dissimilar, though.

When you are working with the wire wound on a toroid, you will notice that it is enameled for insulation. You will have to either scrape the enamel off of the wire tips while you're soldering it to the board, or melt it off with the soldering iron. Melting it off works, but creates a mess. It helps to burn the enamel with a match before scraping.

When winding toroids, space the turns evenly. Do not bunch them.

•A shield around the VFO box can be tack-soldered to the board easily. Just a few tacks to each side will do nicely. You may have to remove it a time or two, so do not solder it down permanently until the very end.

•This board is intended to fit nicely into a project box that is available at Radio Shack. It is approximately 6″ x 5½″. You can mount a speaker against the side wall of the cabinet top, where the vents are located, and is glue it in place. First, glue a small rectangle of cloth to the box, and then glue the speaker to the box. Make sure the material covers only the vents. The speaker must overlap the material to adhere to the box.

•Some components may have to be formed, trimmed, or clipped to properly fit the board. This is especially true of trimmer capacitors which come in many, many different sizes and shapes. Do not be afraid to do some "engineering" in this regard. A ham's ability to do this is what makes this hobby what it is.

•With a direct conversion receiver, it is extremely important to make all connections very solid, especially ground connections. I recommend a double-sided PC board. If you keep grounding foremost in your mind, you will do fine. If a part is to be grounded, you may solder it not only to the pad on the underside of the board but also to the upper side of the board. This is why the copper is not drilled out around the upper part of the board for grounded parts. Use plenty of solder when you attach these parts to each side of the board.

•Make coax and power ground connections to the upper part of the board. Simply solder the shield to the board ground plane on the upper part of the board. The same holds true for the power connection. Insert the positive lead into the proper hole and and solder it to the correct pad on the underside of the board. Then, just solder the negative lead to the ground plane.

•As with any DC receiver, you will hear the signal you are tuned to on both sidebands. The superheterodyne receiver by its very nature only "hears" one sideband. Consequently, you will need to tune to the proper sideband when you want to QSO a station so that you are not way off frequency. Tune on the "lower side" of the zero beat. This will insure that you are in correct position.

•Note the coax jumper from the VFO to the mixer transformer T5. RG-174 is handy for this purpose.

Tune up, Operation, and Troubleshooting

If you have followed the steps above, you have already gotten this rig in an operable state. Simply align the VFO, tweak the driver trimmer C18, tweak the RF amp trimmer, C23, set the RIT control R9 at half scale, and hang on to your hat!

I have made every mistake possible in building this rig. I will gladly respond to written requests for help. I have tried to guide you around some of them so that if you have hesitated to start a project before, you will give it a try this time.

Finding Parts

The parts list, Table 1, gives a Radio Shack part number for most parts needed for this project. The more exotic ones, such as variable capacitors, trimmer C4, toroids, semiconductors, dials, and printed circuit board materials can be found in a number of mail order catalogs. One supplier in particular is dedicated to carrying parts for homebrewers.

Do not be afraid to scrounge around flea markets, surplus electronics parts houses, or your own junk box for parts. My motto is: "When in doubt, try it!" Most metropolitan cities have surplus houses that sell new (or at least unused) parts at dirt cheap prices. You just have to root around for a while to find your treasures. I once found a whole box full of vernier dials that I bought for two dollars apiece. New, they are ten dollars. Persevere, and save on parts!

Good luck and happy home-brewing!

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Carr, "Ferreting out the Problem," *Ham Radio*, June 1988. An excellent instructional on understanding toroids and how to wind them.

Six Meter QRP Station

Who says we don't use tubes anymore?

by Tima Popovich ex-YU1FR

The unit described in this article proved the theory that it is possible to establish contacts at quite respectable distances with very low power.

Designed primarily for mobile use, the station runs from a 6 volt battery. For 12 volt operation, the heaters will have to be rewired and changes made in the power supply. An AC supply is included, making it a station for all-around use.

Before going into the details of construction, here is a brief description of the various parts.

The Transmitter

The oscillator is a Jones circuit which, compared with other circuits, furnishes a high range of potent harmonics. The crystal is of the highest possible frequency so that enough drive is available for the final. The final uses push-pull 6AK5s which, at low input, give 1 to 1½ Watts of output. I used 6AK5s because of their low heater drain (175 mA) and good high frequency efficiency.

The Receiver

The receiver is a superhet with a regenerative detector. This gives the best compromise between battery drain and performance. When possible, I used 6AK5s to reduce battery drain. The line-up uses a 6AK5 oscillator, 12AT7 cascode RF amplifier, 6AK4 oscillator, 12AT7 cascode RF amplifier, 6AK5 IF amplifier, 6AK5 regenerative detector, and 6AK5 audio output. The output is enough to drive a pair of headphones or a small, sensitive speaker. If you want more output, you could use a 6AQ5 at the cost of higher battery drain.

The Modulator

The modulator is extremely simple, consisting of one tube. A carbon microphone provides enough output to drive a 6AQ5, plate and screen modulating the final amplifier. The microphone is coupled to the 6AQ5 through a carbon microphone transformer. The quality is good and there is plenty of modulation.

Power Supplies

There are two independent power supplies in the transceiver. The mobile supply is a conventional vibrator supply delivering about 200 volts at 80 mA. The AC supply is also conventional and delivers the same voltages in addition to rectified and filtered low voltage DC for the operation of the relay and microphone.

Warm Up The Iron!

Now that I've given you a description of the transceiver, the next step is to drag out the soldering iron and begin the construction. The schematic for the transmitter and modulator is shown in Figure 1. The Jones oscillator is of the cathode feedback variety. The feedback is caused by the RF voltage drop across the RFC in the cathode. A small RF choke in parallel with a 3–30 pF trimmer is used. The trimmer adjusts the amount of feedback to compensate for the lack of activity of some crystals. To adjust this, use an inactive crystal and set the trimmer so that the oscillator cuts in smoothly and reliably. This setting will be good for all other crystals.

The choke in the cathode consists of #28 wire close-wound 1″ on a ⅜″ slug-tuned form. The crystal can either be 12.5 or 16.5 MHz. The screen supply of the oscillator has a form of voltage regulation caused by feeding voltage through a 10 k resistor with an NE2 or similar neon connected from the screen to ground. The plate of the oscillator is connected to a transformer consisting of L1 and L2. The final amplifier is a conventional push-pull circuit with L2 as the grid coil and L3 as the tank circuit.

Modulator layout is not critical, the only

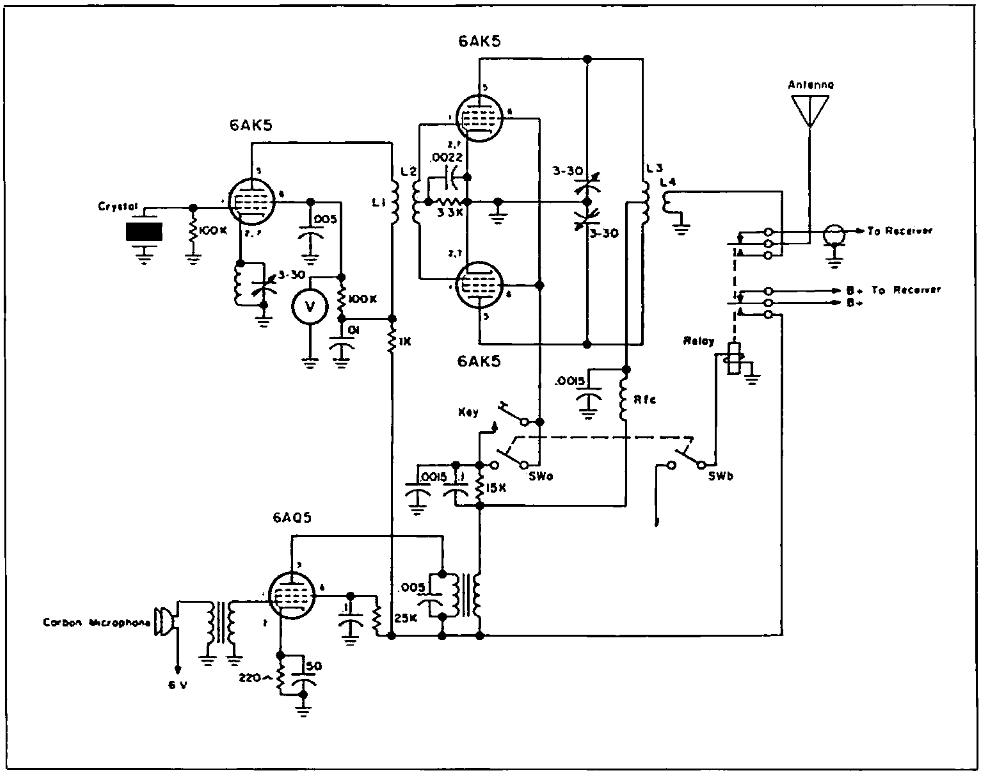


Figure 1. Schematic for the QRP transmitter and modulator.

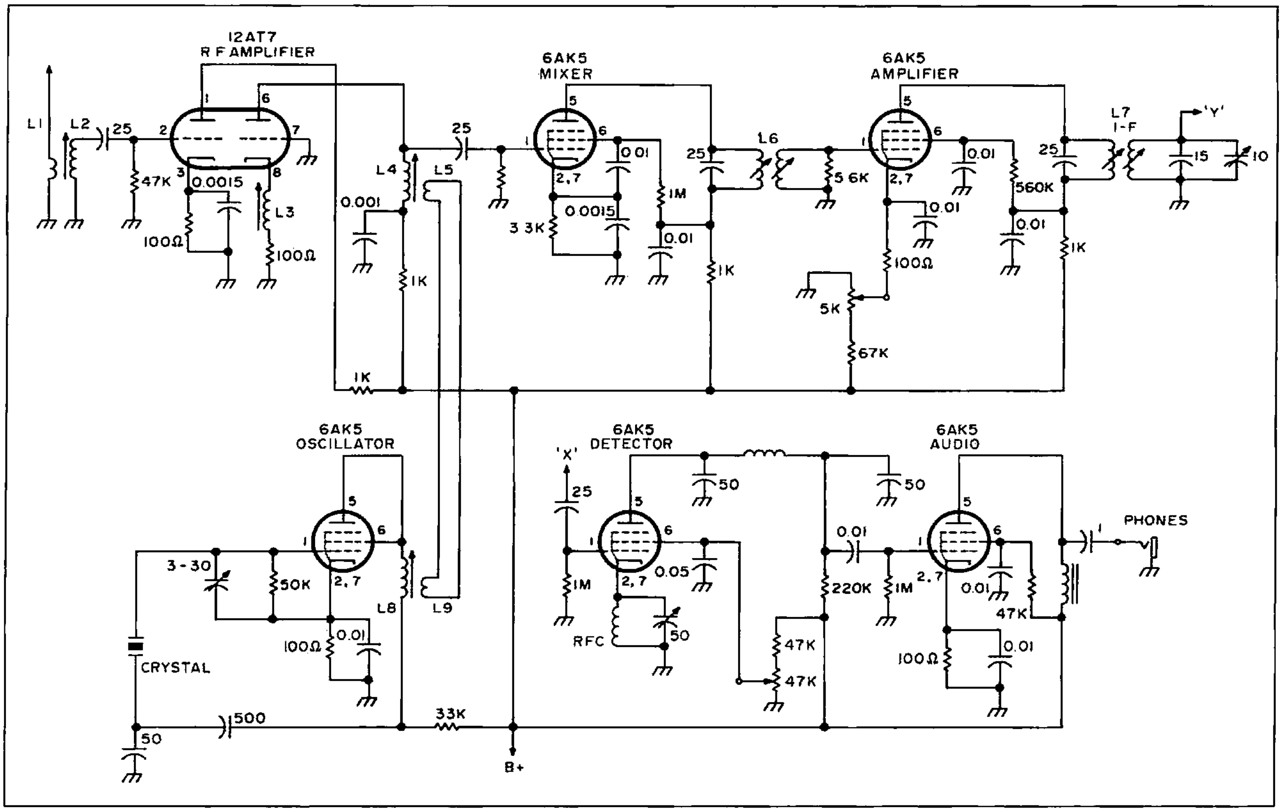


Figure 2. Receiver schematic. Add 100 pF capacitor from pin 1 to pin 8 of the 12AT7.

precaution being that you keep the plate leads away from the grid leads. A 0.005 µF condenser is placed across the primary of the modulation transformer to prevent any undesirable feedback. I wound the modulation transformer myself because there weren't any around at the time. A Triad M4Z or similar transformer is best.

Pay attention to the receiver layout. The RF amplifier is a cascode using a 12AT7 or 6BQ7. Although the cascode was not neutralized, there were no feedback or oscillations. The stage is bandpassed with L2 tuned to the high end. A 10 MHz crystal is used on its third overtone, giving an IF of 20 MHz. It is then coupled through L6 to the regenerative detec-

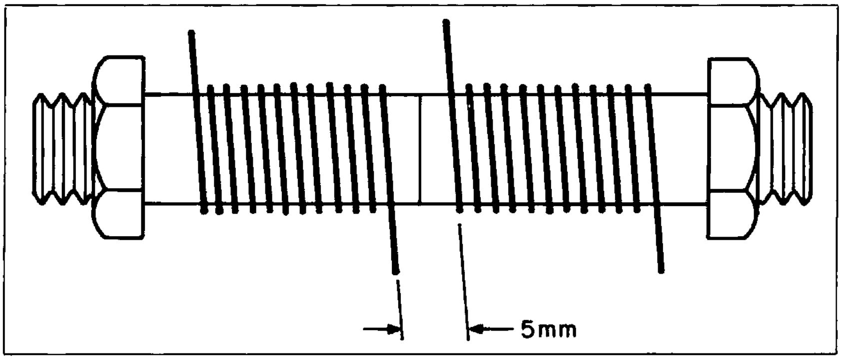


Figure 3. Receiver IF coil.

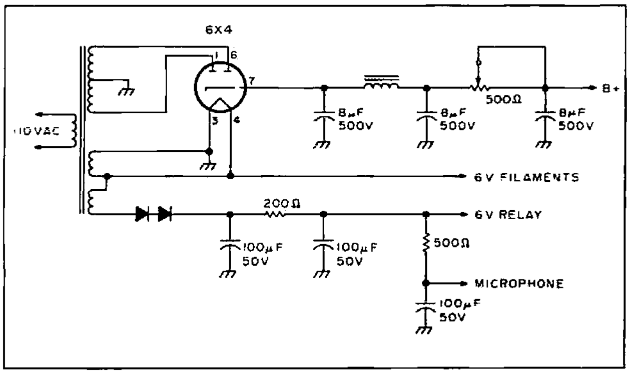


Figure 4. AC power supply.

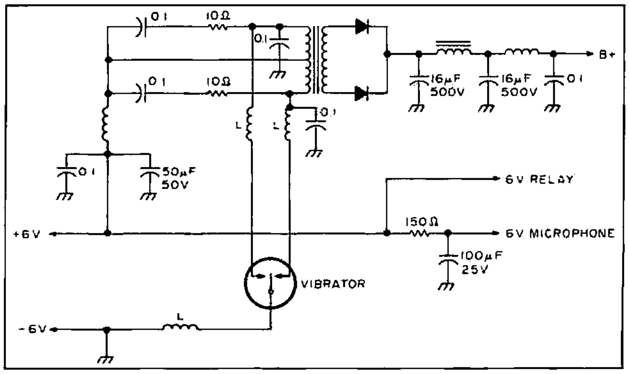


Figure 5. Six volt power supply.

tor. An RF gain control prevents overload of the detector.

The detected signal passes through a filter network which removes RF from the audio. The audio output stage has a choke in the plate circuit which should be as large as possible when used with phones. You could use an audio output transformer with a speaker, instead.

The IF transformers are really no problem to build. The coils are wound on two forms 8 mm (approximately ⅜") in diameter which are joined together as shown in Figure 3. You can substitute standard 21 MHz television IF transformers.

The power supplies are standard and no special precaution has to be taken. The two filament windings are connected in series and rectified to provide low voltage DC for the relay and microphone. There is a resistor for adjusting the output voltage of the transmitter. This should be set to about 200 volts in order to prevent damaging the 6AK5s. The filament leads are shielded to prevent pickup of vibrator buzz when used in mobile operation. The mechanical layout for the chassis are shown in Figures 6 and 7.

Testing and Alignment

Check all voltages. When checking the plate voltage of the 6AK5 detector tube, you should hear a click indicating that the audio works. The most critical part is the IF alignment. Using a signal generator or a grid dip meter, couple a 21 MHz signal into the grid of the 6AK5 mixer and tune the 2 IF transformers for maximum signal. If the signal is too strong, it will whistle strongly, then you may have to slightly drop the screen voltage of the detector. The oscillator is then tuned to the correct frequency. L2, 3, and 4 are tuned as described earlier and adjusted for maximum sensitivity.

Transmitter tune-up is simple. Tune the plate circuit of the oscillator to 50 MHz and adjust the trimmer in the cathode and plate coil for maximum output. Then insert a less active crystal and adjust the cathode trimmer so that it will oscillate without using excessive feedback, which can damage the crystals and cause poor stability. Next adjust the final coils for maximum output.

The unit is now complete. After using it a while, you will be amazed at the performance of such a simple rig. If you take care, you will have a station you can use at home, in the car, or anywhere you want to take it. ■

Taken from November, 1964 73 Magazine.

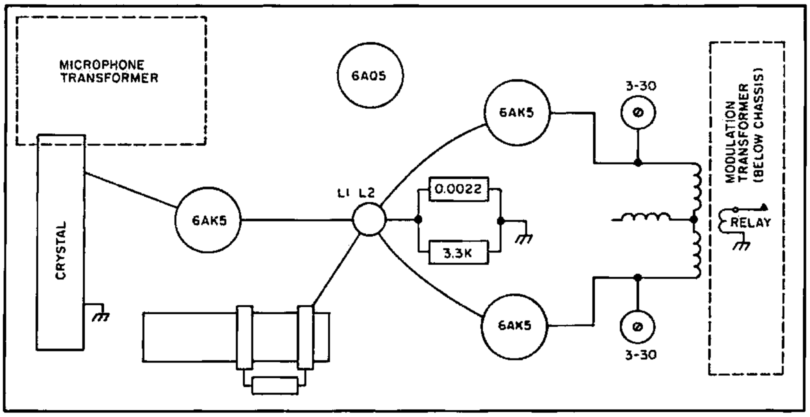


Figure 6. Transmitter layout.

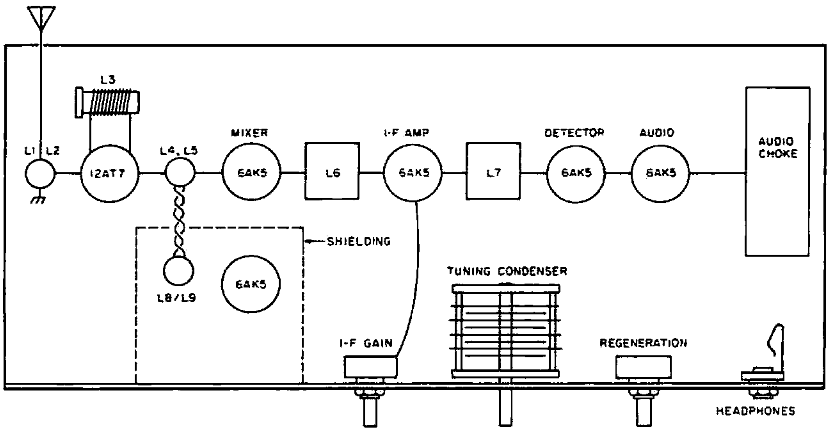


Figure 7. Receiver layout.

Number 16 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free on a space available basis. To make our job easier, and to ensure that your listing is correct, please type or print your request clearly, double-spaced, on a full (8½" x 11") sheet of paper. Use upper- and lower-case letters, and print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Thank you for your cooperation.

I am looking for sources of ham-related and IBM emulation software for the Hewlett Packard HP150 (touchscreen) computer.

Paul Elliott N3GPU
Box 1480
Columbia MD 21044

I need 10 C cell NiCd batteries with solder tabs. Surplus or used would be OK if they are in working condition. Thank you.

Robert F. Cann W4GBB
2708 Old Point Drive
Richmond VA 23233

I'm looking for a Programmer's Tool Kit for Hewlett-Packard HP-110 Portable (or Portable Plus), such as HP calls: "HP 45419C." Also any software for this vintage laptop, preferably amateur radio applications.

Chuck Waite WA3JWF
89 Shagbark Drive
Shavertown PA 18708

Wanted: Manual and schematic for a scanner for the Kenwood TR-7400A manufactured by Amateur Wholesale Electronics. This is the unit with 16 pushbuttons on the front that mount on the underside of the radio. I have one that needs rebuilding. Will pay for copying and postage. Please help me get this puppy running again!

Paul Braun WD9GCO
2102 Yorktowne Drive
Valparaiso IN 46383

Need: Schematic and/or service manual for National NCX3. Will pay copying and mailing costs.

R.G. Ballou K3MQH
3601 Tower Drive
Dover PA 17315

I am looking for hams who manned the US end of the MARS net and fellow GIs who manned the Nam end of the net during 1965–73. I'm writing an article for *The Veteran* that salutes the hams who helped us keep in touch with our families via MARS. Write me at the address below, or call (201) 548-8096 (home), (201) 893-4254 (campus office), or (201) 548-2266 (private office).

Paul A. Scipione, Ph.D.
5 Burr Drive
Metuchen NJ 08840

We are pleased to announce the formation of a licensed ham radio group made up of members of Alcoholics Anonymous. The purpose of the group is to enhance fellowship among the members who may have difficulty attending regular AA meetings. The plan is to schedule contacts via amateur radio at prearranged times and frequencies. Contact:

HAAM RADIO 4+5+9
ARS N8KDW
4121 S. Fulton Place
Royal Oak MI 48072
(313) 549-5275

Number 17 on your Feedback card

73 Review

by Michael Bryce WB8VGE

Antennas West Solar Power Supply

Good for even more than QRP!

Antennas West
Box 50062
Provo, UT 84604
801-373-8425
Price Class: $290 plus $10 shipping

In the past, generating power from the sun was a hit or miss proposition. Most of the early solar electric pioneers used surplus panels, with somewhat less than outstanding results. The technology and economics of converting energy from the sun directly into electricity have improved rapidly.

Antennas West's solar power supply is an excellent first step in converting to solar power. The heart of the Antennas West solar module is the Sovonics P-201 panel. Sovonics is a forerunner in amorphous silicon, or "thin film" cells.

Innovative Development

Until recently, most solar cells were made of crystalline silicon, which has the regular lattice structure of a typical crystal—much like a crystal of salt or sugar. The amorphous, or irregular, structure considerably increases the possibility that light will be absorbed, because the photons interact more with the amorphous structure. This means that an amorphous cell can be made with less material than is needed with the more common crystalline silicon. Amorphous cells can be made only one micron thick, while crystalline silicon cells are typically 300 microns thick. Amorphous silicon cells are applied to a substrate of stainless steel (as Sovonics does). Then the panel is encapsulated in Tedlar™, a time-tested weather-, wear-, and ultraviolet-resistant material.

"Wiring the unit, panel to battery, is quite simple. Only four wires are used."

Sovonics produces their amorphous cell panels very much like newsprint. A roll of stainless steel is on one end of the proprietary continuous roll-to-roll process, and on the other end, out comes a 40 kilowatt roll of solar cells. In this continuous process, layer after layer of semiconductor coating builds up a tandem cell 1/100 as thick as a human hair. The substrate is then cut and installed into different frames for their line of panels. This construction results in a panel that is flexible, lightweight, and unbreakable. However, Sovonics does not stop here. In conventional solar panels, the interconnections between the cells have proven a real pain in the neck. Break one of those interconnections, and the panel is dead. Sovonics has moved all the interconnections to the outer edge of the cells, avoiding the former pitfalls.

Sovonics also has added bridging diodes *within* the panel. By feeling along the back side of the panel, you can spot the diode "bumps." In the older crystalline cell panels, if you lose one cell, perhaps to thermal shock, the panel is useless. The bridging diodes will bypass the cell, allowing the panel to continue to supply power. Likewise, in a conventional cell, a shadow falling across a panel will shut down the entire panel. The Sovonics panel will continue to work.

Up to now, the great majority of solar panels on the market have been in glass. Glass is heavy, and no one would argue that glass breaks. The Sovonics panels can be bent, shot with bullets, dropped, walked on, and generally beat up, and still work. Because of the nature of amorphous silicon cells, they

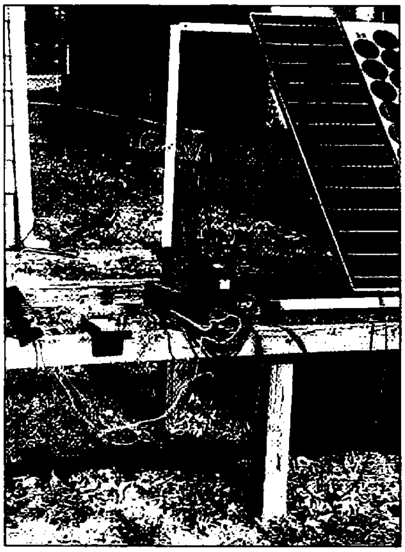


Photo A. Test setup of the entire Antennas West solar package. Note the difference between the P-201 and the corner of the Arco 16-2000.

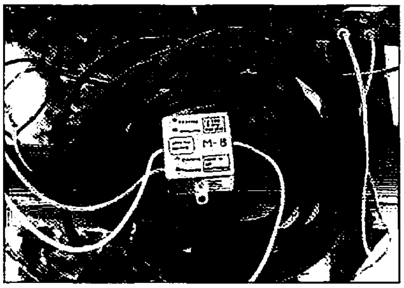


Photo B. The small charge controller that comes with the package is rated at eight Amps.

Photo C. Current of 880 milliamps from a morning sun. Notice shadows under the array. The Sovonics P-201 is in the foreground.

work quite well in diffused light, such as hazy humid weather or cloudy skies. The crystalline cells will fall flat on their faces under those conditions.

Antennas West makes use of the Sovonics P-201 panel. It is rated at 23 Watts under peak sun conditions. This boils down to about 1.6 Amps for battery charging. The P-201 measures one foot wide by four feet long, and weighs under five pounds. Antennas West supplies a 30-foot cable that is attached at one end to the P-201 panel. This is a four conductor cable in which two sets of the wires are connected together. This reduces loss from the panel-to-controller cable.

Setting Up the Panel

Enough on the theory of operation. The Antennas West solar module kit was extremely easy to set up and get running. When you first open the box you'll be greeted by the Sovonics P-201 panel. If you have ever seen one of the crystalline cell panels, all covered with tempered glass and framed in 1/4-inch thick aluminum angle stock, you'll be in for a shock.

The panel looks like it is made of printed cardboard. You can twist and bend the entire panel. Give the center of the panel a good thump with your hand and it yields to the pressure applied. You will also find a bag full of all kinds of things. Terminal strips, nuts, bolts, and various other goodies. The Antennas West solar package is very complete. All you need is a radio and battery. They even included a tube of RTV sealer for repairs and for gluing the panel down on a flat surface. Since the connecting wire between the panel has already been attached, all you need to do is insert the charge controller between the panel and the battery. You will also find a rather large technical manual.

Instructions

The manual needs some attention. It is printed directly from a dot matrix printer. Instead of opening like a book or magazine, the manual opens end to end, much like the old "Thunder Chief" yellow tablets of my school days. The pages of the manual are gummed together at the top. I worry that the pages will fall out under constant use. Unlike the manual that came with your tribander, there is so much information for the new user of solar power, I can envision many a newcomer reading and re-reading the manual. My manual had several typos, and on several pages, some of the print was unreadable. Perhaps the ribbon in the printer got out of its guide when the manual was printing. All and all however, the manual is quite complete. In fact, I talked with Jim Stevens, of Antennas West, about changing the layout of the manual so it would open like a magazine. I also suggested adding three hole punch-outs to each page.

I was very glad to find out what you can and cannot operate from the 23 Watt P-201 panel. 23 Watts is not much power, unless you know how to put it to use. And I'm not talking about running QRP equipment, either, but also 200 Watt radios. The manual goes into great detail on computing your power consumption at your location. A very good section on battery selections, along with charge control, rounds out the manual. The technical manual is 41 pages long.

The Antennas West solar kit also comes with a series switch charge controller. This will keep the battery(ies) from overcharging. By monitoring the terminal voltage of the battery, a relay will open up and stop all flow of current to the battery, preventing overcharging. The controller will then monitor the voltage of the battery and will turn on the series relay to maintain the full charge terminal voltage. This "pulse" charging will reduce battery gassing considerably. The controller works super well with the sealed gell/cell batteries. The controller was designed by KA8IDB. It is potted in epoxy and is quite small—about two inches square. Wiring the unit, panel to battery, is quite simple. Only four wires are used. The charge controller can be mounted on a wall with the wood screws supplied or with some double-backed tape, also supplied.

"It's lightweight, vandal resistant (repeater operators take note), and should provide year after year of trouble-free energy generation."

Since my entire station operates from solar power, I isolated some of my gear to operate directly from the Antennas West solar kit. I used my Argosy transceiver and a KDK 2 meter mobile. A 50 Ah gell/cell battery was used for energy storage. I mounted the P-201 alongside my other panels on the array rack. This rack is tilted to optimize my location.

The P-201 is rated at 23 Watts peak output. This happens when the isolation from the sun is 1000W/m^2 at 42°C, a widely accepted standard. In real life, we can count that amount of sun on one hand, (if you live in Ohio). Using digital current and voltmeters, I measured maximum current of 1.4 Amps several times. Depending on the state of charge of the battery and the isolation of sunlight, you may not see the rated 23 Watts. In mid-March, I averaged close to 18 Watts. No question, had I lived in the Sun Belt, I would have received higher Watts/day.

Operating my 100 Watt Argosy and 2 meter FM radio, I had no trouble maintaining communications. I operated several hours a week, mostly on CW. The FM gear was used more, about 10 hours per week. Had I operated more, or changed to a higher power radio, I could have added more panels in parallel to boost charge current. No question about it, 23 Watts is not much, but that is the beauty of solar power—You can add panels as your needs grow.

For larger power requirements, I would recommend the use of a larger Sovonics panel, along with a charge controller that will handle the higher current. You can purchase additional P-201 panels from Antennas West for about $200. That breaks down to about $8 per peak Watt. You can do better, *if* you know what to buy and how to interconnect the different systems together.

Drawbacks

Were there some things that I did not care for? The Sovonics panel, as super tough as it is, is a little rough around the edges in quality. I have talked with the people at Sovonics and they acknowledge the quality control problem. New equipment is being installed to improve quality control. The panel that came with the review unit, while working perfectly electrically, had some workmanship defects. There were holes that were drilled off-center on the back side of the panel. Since the panel does not have a frame as such, the aluminum sheet that the laminate is bonded to was not folded over properly.

You should be aware of some of the down sides to amorphous silicon solar panels. Since Sovonics panels are made using amorphous silicon, they suffer (as do all amorphous silicon solar cells) from a small degree of degradation. The panels are not as stable as their crystalline counterparts. The power output will drop as they age and then level off, usually within the first 30 days or so. Sovonics panels degrade about 10% of their rated power. The stainless steel substrate used by Sovonics has an "annealing" effect on the cells. It seems that after an initial drop in power, the panel will come back up slightly. That is why Sovonics rates their panels lower than other manufacturers. This gives the end user a more realistic power capacity.

Because amorphous silicon panels are less efficient, you'll require twice the surface area for the same amount of energy produced using a crystalline cell panel.

All and all, I was very happy with the Antennas West QRV solar package. After you get used to the strange appearance of the Sovonics panel, you'll find it a strong performer. It's lightweight, vandal resistant (repeater operators take note), and should provide year after year of trouble-free energy generation. Even if you don't want to limit yourself to only 23 Watts, just keeping the module in the closet will provide emergency power for those times when you may need electricity most. If you like the idea of using solar energy to help power your shack but don't want to spend a lot of time and money, the Antennas West QRV solar package is ideal. And if you want to keep connected to the grid, but like the idea of a small emergency power supply, again this solar package fits the bill.

The Antennas West QRV solar package is the most complete and thought-out design for the newcomer to solar electric power on a small scale. 73

Decoding OSCAR Telemetry — Part II —

by James R. Miller G3RUH

Part I of this article. (in the May '89 issue of *73*) covered telemetry info on OSCAR-9 (UoSAT-1), OSCAR-11 (UoSAT-2), and OSCAR-13 (P3C). This final part covers telemetry info on Fuji-OSCAR-12 (F-0-12), and some birds yet to be launched: UoSAT-D and the Microsats. (Note that F-O-12 is NOT the same as UoSAT-D.)

Photo A. FO-12 PSK Packet Radio Modem. This uses regular CMOS/TTL chips and no hard-to-get parts. This modem is used with the FO-12 flying BBS and AMSAT-NA's forthcoming MicroSats. PSK modems are also used for PSK packet experiments terrestrially, through OSCAR-13's voice transponder, and even meteor scatter.

Fuji OSCAR-12

General: JAS-1 or Fuji-OSCAR-12 was launched on August 12, 1986 from the southern tip of Japan. It carries two transponders: a traditional one for SSB/CW, and the world's first spaceborne packet radio BBS. In orbit 1600 km (1000 miles) high, it's inclined at 50 degrees to the equator with a period of 120 minutes. It offers users an aggregate of two hours communication per day. When in SSB/CW mode, it sends telemetry in Morse code on 435.795 MHz. When in the digital mode, telemetry and traffic is in the AX.25 packet format on 435.910 MHz. Nowadays, FO-12 is somewhat troubled by insufficient power from the solar panels to support the digital mode full-time. The improved JAS-2 is in preparation and, based on the experience of its predecessor, it should be highly successful.

Since the digital mode supports a packet mailbox, users can also transmit data in the 2 meter band to the satellite. The modulation format, however, is *not* the same as for terrestrial packet. Nevertheless, you do need a packet radio Terminal Node Controller (TNC).

Data Transmitted: In the digital mode, FO-12 sends its telemetry in "unconnected" AX.25 packet frames, which appear on your terminal as seen in Figure 1. You will see that the telemetry contains 40 numbers which you can decode into voltages, currents, temperatures, status points, etc., using the published equations. For example, the first item is "Total Solar Array Current, mA," and decodes as I = 1.91 x (N-4). Setting N = 275, you find that this current is 518 mA.

In addition to the telemetry data, you would also be able to monitor the packet traffic. This looks no different from the familiar terrestrial scene, except it's faster!

Telemetry Format: In contrast to conventional local packet radio, which uses two tones (AFSK) to signal binary "0" or "1," FO-12 uses phase shift keying (PSK) modulation. The carrier phase is changed by 180 degrees (inverted) when a change in binary level is signaled.

The downlink carrier on 435.910 MHz passes through a balanced modulator driven by the AX.25 digital data at 1200 bits/s to generate PSK.

The uplink is different: 1200 bits/s data is exclusive-ORed with its 1200 Hz clock (called "Manchester" coding), and this audio is transmitted FM on 145.850, 145.870, 145.890, or 145.910 MHz.

Telemetry Demodulation: A PSK demodulator consists of a phase reference derived from the received audio with a special phase-locked loop (PLL), and a phase detector to extract the phase changes and convert them to digital bits. In addition, the received signal is subject to 16 kHz total Doppler shift due to the spacecraft's movement, at a maximum rate of 40 Hz per second. Tuning the receiver by hand to follow this is practically impossible, so an auto-tune circuit is essential, especially if you want to turn antennas and operate a keyboard as well.

The G3RUH FO-12 PSK Modem provides all the above functions plus an uplink modulator. It has been available since 1986, with about 500 presently in use. This modem can also be used for experimental PSK work either terrestrially or through OSCAR-13's voice transponder. A power advantage of some 10 dB over normal packet signaling is typical.

Decoder/Modem Specifications:

Downlink—Input 50 mV to 5V RMS audio from SSB/CW receiver. PSK demodulator. Output TTL digital, 1200 bps.

Uplink—Input TTL digital, 1200 bps; Output, 1200 bps Manchester encoding modulator to mike level.

Connects—To AX.25 TNC's "modem disconnect jack." Suitable for TNC-2 and derivatives, such as TNC-200, TNC-220, Tiny-2, PK-80, PK-87, PK-88, etc.

Digital AFC—Tracks changing Doppler shift via the up/down lines of all known ICOM, Trio/Kenwood, and Yaesu receivers.

Controls—Auto-tune on/off, PLL bandwidth, Lock/Tune/Power LEDs.

Set-up—Three trim pots; PLL frequency, ½ supply voltage, and up/down tuning sensitivity set.

Power/PCB—12V @ 40 mA. Built-in AC PSU options. Double-sided plated through PCB, 160 x 100 mm. 11 ICs, 40 resistors, 25 capacitors.

Availability—The PCB is available from AMSAT-UK (17 pounds airmail). You may also order it from AMSAT-VK and Project OSCAR. RadioKit sells the PCB plus full kit of parts. AMSAT-NA stocks no satellite products, though this could change in response to demand. Phone to check. All addresses and numbers are at the end of this article.

Associated Equipment: You must use a 70 cm SSB radio to receive FO-12 on 435.910 MHz. Tuning rate should preferably be 20 Hz/step or better. You can use 100 Hz steps, but at the expense of data errors when badly mistuned. You can take audio direct from the external speaker socket. Some receivers will

Designation	Name	"Owner"	Mission
MicroSat-A	PACSAT	AMSAT-NA	Packet Radio BBS (PACSAT)
MicroSat-B	DOVE	BRAMSAT (Brazil)	Voice synthesis experiment
MicroSat-C	NUSAT	Weber State Univ	CCD TV Camera Experiment
MicroSat-D	LUSAT	AMSAT-LU	Packet Radio BBS (PACSAT)
Designation	**Downlink**	**Uplinks MHz**	**Signaling Format**
MicroSat-A	437.050	145.900/920/940/960	AX.25 1200 bps as FO-12
MicroSat-B	145.973	—	BFM Voice
MicroSat-C	437.100	—	AX.25 1200 bps as FO-12
MicroSat-D	437.150	145.840/860/880/900	AX.25 1200 bps as FO-12

Table 1.

have a separate AF output socket on the rear panel that bypasses the volume control. To transmit on the uplinks, you need a 2 meter FM transmitter.

FO-12 is very strong, so you can use a vertical collinear antenna at close range. Many operators favor beam antennas, though, and they will have more than enough gain for practical purposes. Steering in azimuth is then essential, and elevation highly desirable, if you want to be able to observe all passes.

An AX.25 Terminal Node Controller (TNC) is essential for use with a suitable VDU or computer terminal just as for terrestrial packet. You can process telemetry data by hand or by a simple program on the computer. It is *not* possible to display the raw data directly from the modem on a VDU or 1200 baud terminal, as it is in AX.25 packet format.

Reading: The *FO-12 Handbook* contains full descriptions of the satellite and its systems, as well as essential details of telemetry decoding.

Fuji-OSCAR-12 Technical Handbook, AMSAT-UK, London, E12 5EQ, England, 64 pages (obtain from AMSAT-UK, 4 pounds airmail, AMSAT-VK, or Project OSCAR).

Miller J.R., G3RUH, "A Packet Radio PSK Modem for JAS-1/FO-12," *Ham Radio*, February 1987, pp. 8-22.

Microsats

General: Four small Microsats, conceived by AMSAT North America, are presently under construction and testing. Launch is scheduled for the second half of 1989, along with UoSAT-D (and, of course, the primary commercial mission SPOT-2). See Table I for a summary of their main features. Their orbits will be circular, much like UoSAT-2's, and polar with a 99-minute period and appearances around 10:30 a.m. and 10:30 p.m. local time. They will be stabilized, Earth-pointing, with strong signals, hopefully requiring only omnidirectional antennas.

At the time of writing this article (February 1989), details of the telemetry data and packet BBS access have not been finalized, but we expect them to be quite straightforward.

Associated Equipment: Since communication with Microsats A/C/D will be identical to communication with FO-12, simply refer to the FO-12 section of this article for details of the equipment you need.

Reading: The Microsats are new, and the concept is evolving fast. The paper by Tom Clark sketches the program from its conception to today, and explains the designs in a very readable and entertaining style.

Clark T., W3IWI, "AMSAT's Microsat/PACSAT Program," *Proceedings of the 7th ARRL Computer Networking Conference*, October 1988, pp. 41-47.

Johnson L.V., WA7GXD, "Microsat Project—Flight CPU Hardware," *Proceedings of the 7th ARRL Computer Networking Conference*, October 1988, pp. 104-106.

Price H., NK6K, and McGwier R., N4HY, "PACSAT Software," *Proceedings of the 7th ARRL Computer Networking Conference*, October 1988, pp. 145-149.

UoSAT-D

General: UoSAT-D is scheduled for launch on Ariane in the second half of 1989, with 4 AMSAT Microsats and the primary commercial mission, SPOT-2.

The orbit will be circular, much like UoSAT-2's, polar with a 99-minute period and appearances around 10:30 a.m. and 10:30 p.m., local time, with strong signals. Hopefully, it will require only omnidirectional antennas.

The downlink frequency will be around 437 MHz FM, and user uplink around 145 MHz FM. UoSAT-D will use a 9600 bits/s data rate in both directions with AX.25 packet radio format.

As above, details of the telemetry and packet BBS access have not been finalized yet, but we expect them to be straightforward. As the number of experienced users grow, we foresee more automated communication.

Telemetry Format: Uplink and downlink will use 9600 bits/s direct FSK. That is, "1" will cause an increase in carrier frequency, and "0" a decrease.

Precisely controlled shaping of the bit transitions will be essential to constrain the data's audio spectrum to under 7 kHz, and to ensure reliable communication through conventional FM radios with a 20–25 kHz radio channel.

The data will also need to be randomized (scrambled) before transmission, and unscrambled again after reception. This is to ensure that no long runs of all "1s" or all "0s" are transmitted, which would be especially error-prone in this modulation arrangement.

Because the audio bandwidth is somewhat wider than the normal voice, signals must go directly from the receiver's FM discriminator to the transmitter's varactor frequency modulator.

Telemetry Demodulation: The G3RUH 9600 Baud Packet Radio Modem was introduced in mid-1988, and by February 1989 some 500 modems were in worldwide circulation for high speed terrestrial packet radio links.

UoSAT-D has an identical modem design onboard. The modem provides all the modulation and demodulation circuits required for UoSAT-D. It's designed for use with a Terminal Node Controller (TNC), typified by the TNC-2, TNC-200, TNC-220, Tiny-2, PK-80, PK-87, PK-88, etc. It's a high performance, full-duplex modem that works with most voiceband NBFM radios, assuming only minor modifications.

A key feature is digital generation of the transmit audio waveform. Precise shaping compensates for the amplitude and phase response of the receiver. This results in a "matched filter" system, which means that the received audio offered to the data detector has the optimum characteristic (eye) for minimum errors. It also allows very tight control of the transmit audio bandwidth.

Decoder Specifications:

Modulation—FM. Audio applied direct to TX varactor. ± 3 kHz deviation gives RF spectrum 20 kHz wide (−60 dB). Fits standard channel easily.

TX Modulator—Eight-bit long digital F.I.R. transversal filter in EPROM for transmit waveform generation (12-bit optional). Gives "brick-wall" audio spectrum. Typically −6 dB at 4800 Hz, −50 dB at 7500 Hz. Allows compensation for distant receiver (the channel) to achieve perfect

```
8J1JAS>BEACON <UI C>:
JAS-1 RA 88/03/19 07:11:58
275 546 684 690 743 876 887 861 002 349
644 001 519 532 538 546 548 538 686 001
710 712 690 746 738 674 921 144 000 000
010 101 100 000 100 000 001 101 111 000

8J1JAS>BEACON <UI C>:
JAS-1 MO 88/03/19 07:12:00
Mailbox available.
Software loaded at 88/03/17 05:25:00
Mode JD Transmitter will be toggled ON/OFF
every two hours using this epoch.
```

Figure 1. FO-12 telemetry in "unconnected" AX.25 packet frames as they appear on your terminal. The telemetry contains 40 numbers which you can decode into voltages, currents, temperatures, status points, etc.

RX eye. Up to 16 TX waveforms (32 optional), jumper selectable. Output adjustable 0–8 V, pk-pk.

Scrambler—(Randomizer): 17-bit maximal length LFSR scrambler. Jumper selectable Data or BERT (bit error rate test) mode.

RX Demodulator—Audio from receiver discriminator, 50 mV–10V, pk-pk. 3rd order Butterworth filter, 6 kHz. Data Detect circuit for use on simplex (CSMA) links. Independent unscrambler. New digital PLL clock recovery circuit with 1/256th bit resolution. Average lock-in time, 50 bits (depends on SNR).

Connects—to AX.25 TNC "Modem Disconnect" jack. Suitable for TNC-2 (and any other, provided the internal modem can be bypassed). Standard TNC digital connections needed: TXData, TXClock (16x bit rate), RXData, Data Detect ("DCD"), GND. TTL levels. RADIO: TX Audio, RX Audio, GND.

Power/PCB—10-15 V DC at 40 mA (CMOS ROMs), 170 mA (NMOS ROMs). Total 19 ICs (13 CMOS, two DACs, two EPROMs). 5 volt regulator and heat sink. 160 x 100mm double-sided, plated through, solder resist, full ground plane. No hard-to-get parts. Instruction booklet, 16 pages.

Availability—The PCB is available from G3RUH (19 pounds airmail plus 6 pounds for the pair of EPROMs, which you may copy). Assembled/tested boards can be obtained from Pac-Comm. RadioKit plans to stock complete kits of parts—check. Project OSCAR will take PCB orders. Canadian outlets are being arranged.

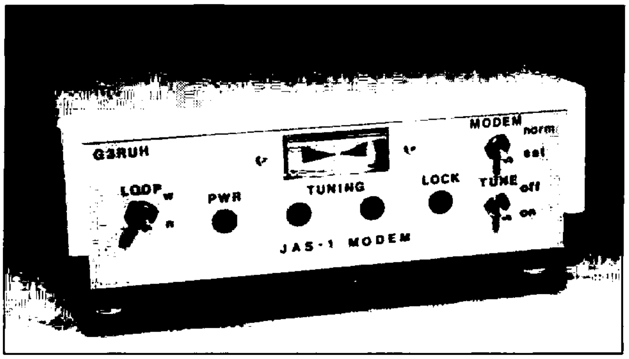


Photo B. FO-12 PSK Modem in cabinet showing controls.

Associated Equipment: You can use a 70 cm FM radio to receive UoSAT-D. Tuning rate can be quite coarse; 1 kHz steps will be adequate. You must take audio direct from the receiver's FM discriminator, implying a minor internal modification. To transmit on the uplink, you need a 2 meter FM transmitter. Apply modulation directly to the varactor to provide true FM. UoSAT-D should be strong. A vertical collinear antenna may be adequate at close range.

An AX.25 Terminal Node Controller (TNC) is essential to use with a suitable VDU or computer terminal, just as for terrestrial packet. It is *not* possible to display the raw data direct from the modem on a VDU or 9600 baud terminal device as it is in AX.25 packet format.

Reading: Ward J., GØ/K8KA, "The UoSAT-D Packet Communications Experiment," *Proceedings of the 7th ARRL Computer Networking Conference*, October 1988, pp. 186–193.

Miller J.R., G3RUH, "9600 baud Packet Radio Modem Design," *Proceedings of the 7th ARRL Computer Networking Conference*, October 1988, pp. 135–140. ■

CIRCUITS

Number 19 on your Feedback card

Great Ideas From Our Readers

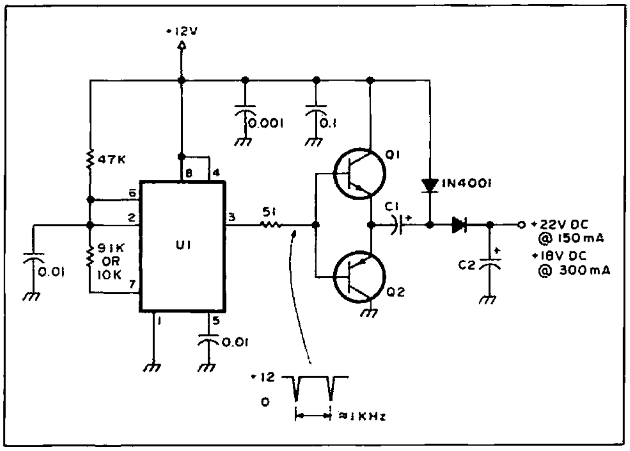
Voltage Doubler Circuit

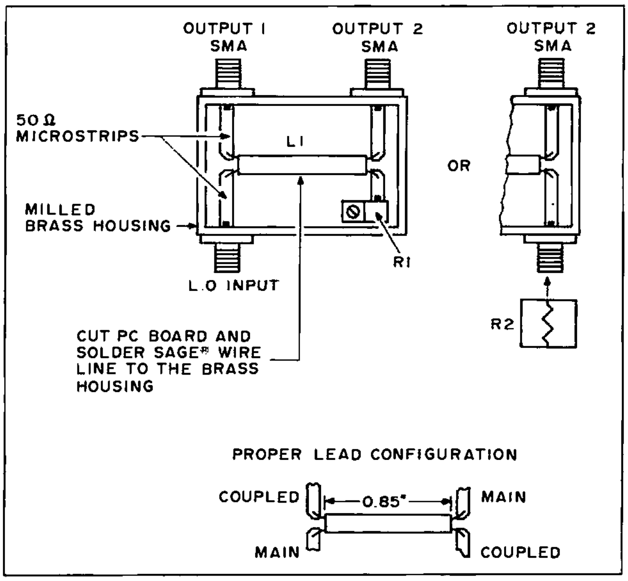
I've used this circuit for the past two years to drive relays of 24 and 28 volts DC from a 12-volt power supply. It is a DC-DC converter which powers a 28-volt DC antenna relay. You can use this circuit with almost any PNP or NPN power transmission. It will work the first time every time.

At hamfests, 28-volt relays often cost less, but because of the voltage rating, most hams don't buy them.

Parts: For U1, you'll need a NE 555 timer. C1 & C2 require 50 µF/ 25 volts DC. NPN, Q1: TIP29; TIP120; 2N4922; TIP61; TIP110; and 2N4921. PNP, Q2: TIP30; TIP125; 2N4919; TIP62; TIP62; TIP115; and 2N4918.

Chuck Steer WA3IAC
Philadelphia PA





2-Way 2304/2160 MHz Power Divider

Here's a handy little device for 13cm enthusiasts. This allows a user to split the power of the precision LO input into two 50Ω equal power 2160 MHz non-interacting signal sources. Both outputs go to their respective receive and transmit mixers, which are independent of each other.

SMA stands for small miniature adapter, one of only several connectors that should be used at 2 GHz and above. Check also Sealectro, Inc., 225 Hoyt St., Mamaroneck NY 10543, for microwave-band connectors.

Parts: L1 = Sage® 3 dB wireline; R1 = 50Ω microstrip-type termination; R2 = 50Ω termination.

D. Mascaro WA3JUF
Ottsville PA 18942

CW Transceiver for 20 Meters

Get on this favorite DX band.

by Frank Lee G3YCC

Adapted from G-QRP Club Circuit Handbook

Are you ready for the challenge of 20m QRP? Want the added enjoyment of rolling your own rig? If so on both counts, then check out the following home-brew project! This interesting little project uses components ranging from tubes to ICs.

Hybrid

Some of the modules used to build this rig were removed from existing equipment; others were built specially. This explains the different devices for the TX modulator and the RX mixer, the option of two carrier injection oscillators (CIO), and the SSB-type filter instead of a CW filter.

Circuit Description

The Colpitts VFO circuit, Figure 1, has gate clamping to improve stability. It's followed by two buffers, the second providing individual outputs to the TX and RX. A RIT circuit operates on receive. You must set it up correctly when you first align the rig (see instructions below).

Build the VFO in a stout metal box, with care for mechanical rigidity. The RX front end uses 40673 dual-gate MOSFETs (see Figure 2). The tuned circuits are peaked to the center of the CW band with trimmers.

Coil winding details for the VFO and other stages appear in the respective figures.

The mixer output is link-coupled to a KVG 9 MHz SSB filter, whose output is amplified by an SL612 IF amplifier IC (see Figure 3). The product detector uses two BC 107 transistors. Carrier reinjection is from a crystal oscillator using the USB crystal supplied with the KVG filter. Figure 4 contains two diagrams: an FET oscillator and a PNP bipolar oscillator. You can use either, or you can alter the circuit polarities to suit an NPN transistor. An LM380 IC would work fine here.

The TX mixer is an MD108 (Figure 5), fed from the VFO and the lower sideband carrier injection oscillator. (You could probably use the less expensive 40673 as a mixer.) The mixer output is applied to an SL610C RF amplifier, then to a FET which drives a 12BY7A PA similar to that in the well-known "Tucker Tin" circuit. I tried to use a transistor PA, but had troubles with it (likely due to my lack of experience in transistor PA design!).

A simple diode/meter circuit measures relative power output (see Figure 6). Sidetone is provided by an NE555 circuit (see Figure 7).

Send/receive switching is by means of a 4-pole change-over relay controlled from a

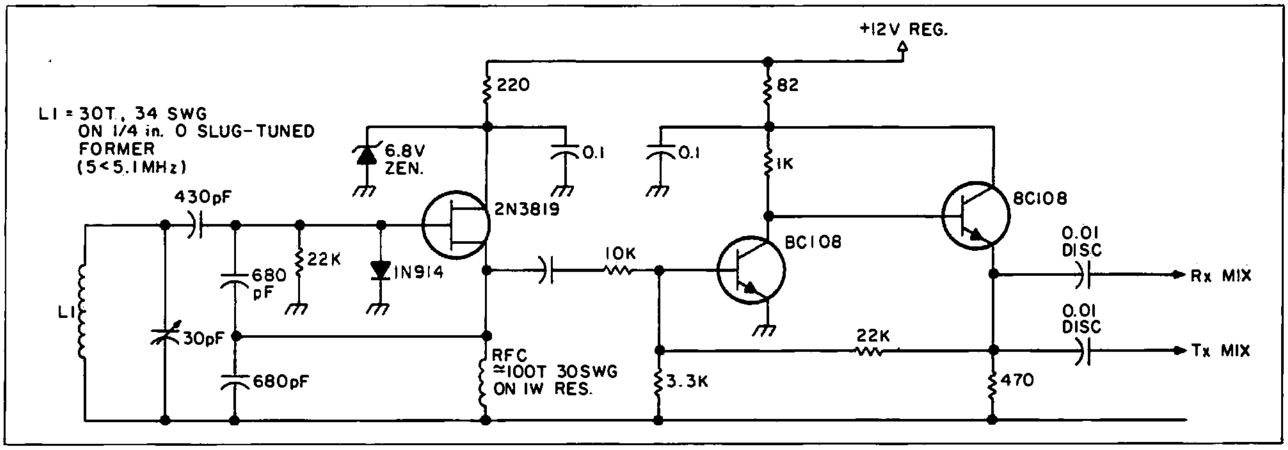


Figure 1. Colpitts VFO circuit.

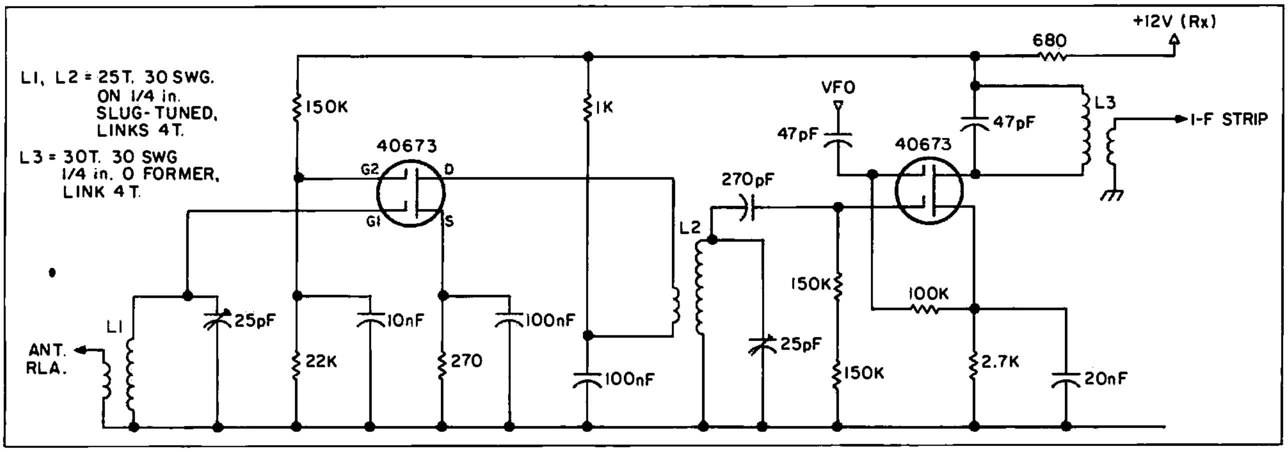


Figure 2. The receive front-end. The associated tuned circuits are peaked to the center of the CW band with trimmers.

switch, with one spare contact set. A reed relay is used for keying. You could also operate this rig on 80 meters after selecting the appropriate VFO and CIO frequencies and changing the appropriate coils.

RIT Alignment

Alignment is conventional except for the RIT (Figure 8), which must be set up as follows to compensate for the frequency difference between the two CIO crystals:

1. Using an external receiver with no aerial connected, and a signal source such as a crystal calibrator, switch the transceiver to "send" and zero beat it with the signal source.

2. Switch the transceiver to receive, then use the RIT control to zero beat it with the signal source. Carefully mark the setting of the RIT control on the front panel of the transceiver so that it can be accurately repeated.

3. When searching the band, do so with the RIT control set to this mark. If it is required to net on to another station, tune to zero beat, then off-set the RIT control to give the required beat note. After a QSO or an unsuccessful call, always reset the RIT control to its zero mark in readiness to zero beat with the next station to be called.

So what's the best DX so far with this rig? A VK answered a CQ from G3YCC—you can't get too much further than that! 73

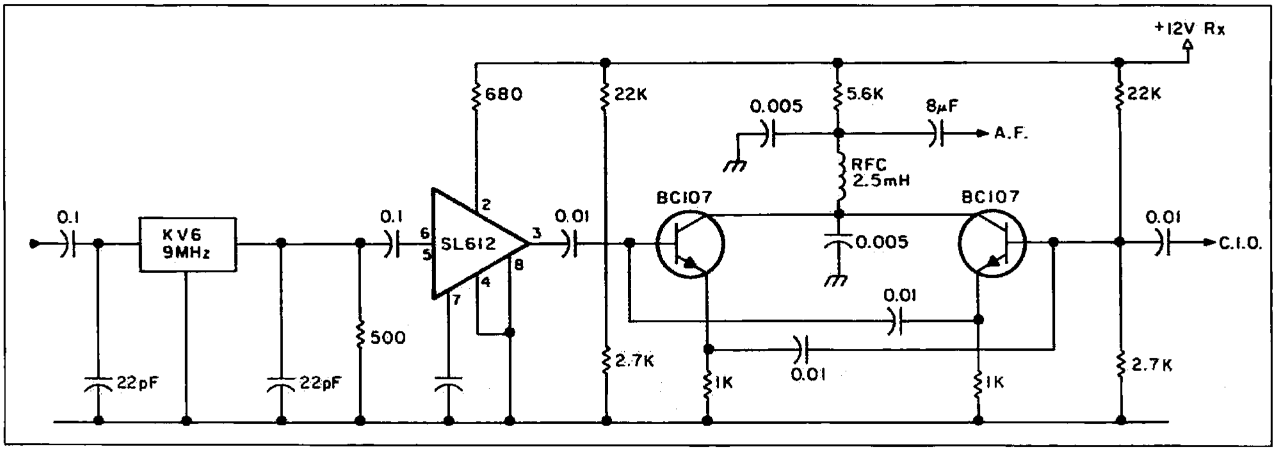
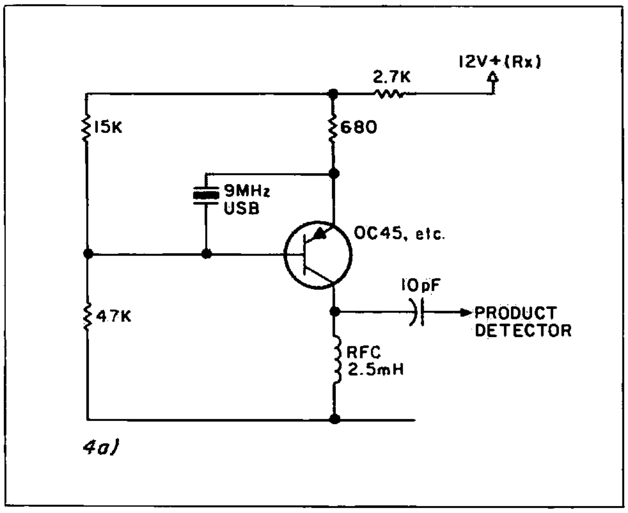


Figure 3. Receive filter, IF, and product detector.



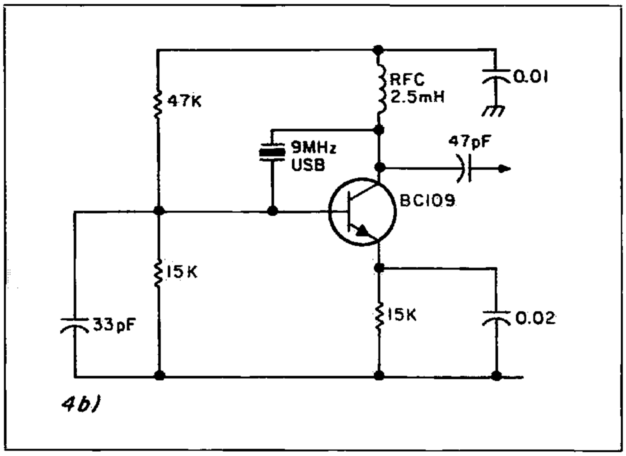


Figure 4a,b. What's in the junk-box? Pick between two receive carrier circuits.

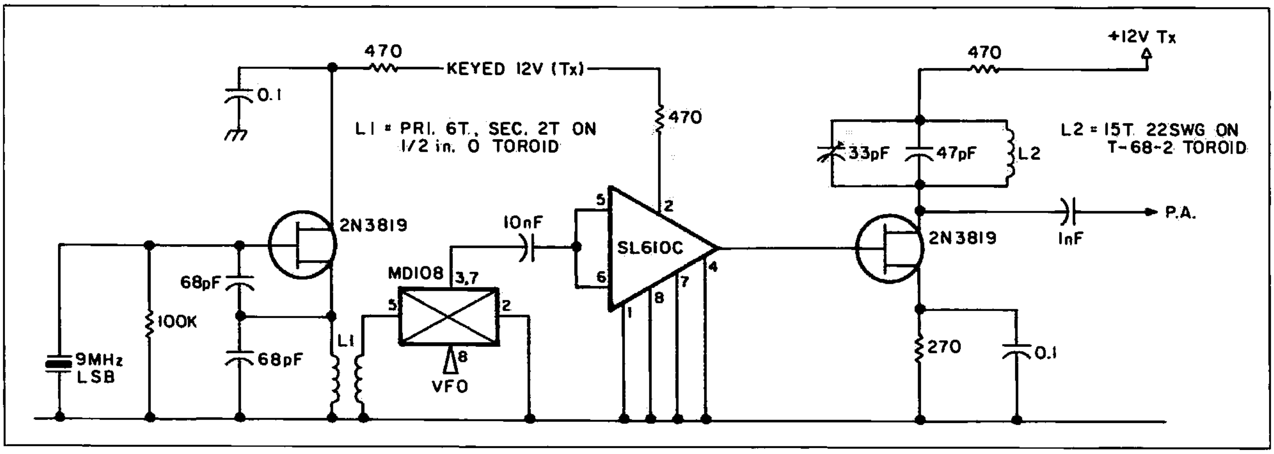


Figure 5. Transmit mixer and predriver.

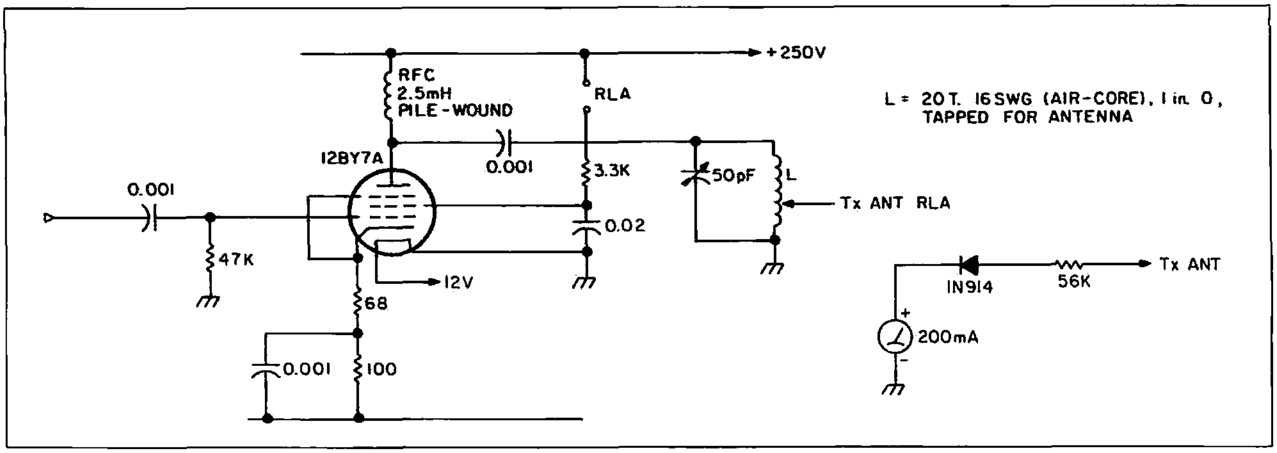


Figure 6. A simple diode/meter circuit to measure relative power output.

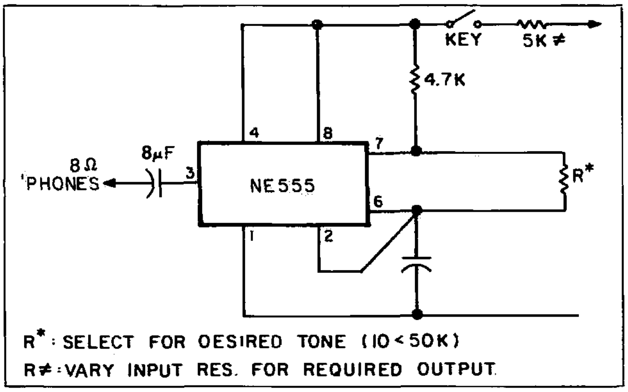


Figure 7. Sidetone circuit.

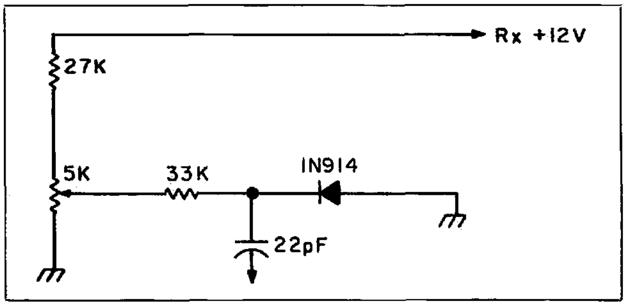


Figure 8. RIT circuit. Set RIT to compensate for the frequency difference between the two CIO crystals.

ABOVE AND BEYOND

VHF and UHF Operation

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10 GHz ARRL Contest Preparations

In April, I covered the construction of a tripod and microwave dish antenna for use on 10 GHz. This month I would like to continue with local involvement and where to get equipment to operate on the microwave bands. The prime goal is to prepare for the 10 GHz ARRL contest later this summer. This month, let's cover some of the things that you can do in your own area to enhance operation on microwave.

At first I thought San Diego was dormant until N6IZW and I started to talk about operations on the local repeater and at swap meets. This resulted in quite a few fellow amateurs forming a common interest forum, the San Diego Microwave Group. Through discussions, we began forming a common bond, which has grown and spread quite widely. Participation in a local group stimulates interest and helps us sort out data from other parts of the country. This assists us in experimenting.

As to equipment, you have basically two choices: buy the very fine M/A COM Gunnplexer, or obtain surplus microwave equipment at swap meets or even possibly for free.

Scrounging for Equipment

By scrounging, you can get QRV on the 10 GHz microwave band for next to nothing. The quality is not as good as the M/A COM Gunnplexers, but it will work well. Go to your local burglar alarm and electric door companies and try to obtain some of the older microwave control units they no longer use, since they're switching to I.R. optical units.

Pat AA6EG wrote to me questioning the use of a peculiar type of alarm unit and detector diode current. See Figure 1 for details. You can check the detector for injection with a meter (0 to 1 mA) in series with the detector diode and ground. With the transmit source on, you should observe a DC current flowing in the detector. About 0.5 to 0.7 mA is optimum. Adjust the frequency of the transmit source to the ham band, usually about 10.250 GHz, by lowering the frequency adjust screw further into the cavity about 1 to 2 turns. The microwave unit is set in the factory to around 10.525 GHz.

The only limiting factors with surplus devices are the system sensitivity and any gains associated with detector noise and antenna types. Remember the SOLFAN types were intended to be short range devices, but they work very well for the small cost of obtaining them.

Transmitter output power is a consideration, but you may be surprised with what you can do with 10 mW. Usually, with modest transceivers and small horns, 25 miles is the limit. With larger dish antennas, 200-mile contacts are possible.

By the way, I still have a quantity of 50 to 100 mW 10 GHz Gunn devices available for $5 each postpaid.

Success Stories

Steve KA0ZIL from Plymouth, Minnesota, writes: "I had some time off from work, so I called some local automatic door companies. I picked two out of the several listed because they were local companies. I struck paydirt with both calls. At one, the tech is going to clean up the shop next week and set aside all microwave units he would otherwise toss out. The other shop had two units for me! One was an old SOLFAN with a detector, and the other was a small black box, like the ones above the doors at the grocery store. The kicker is that they both work!"

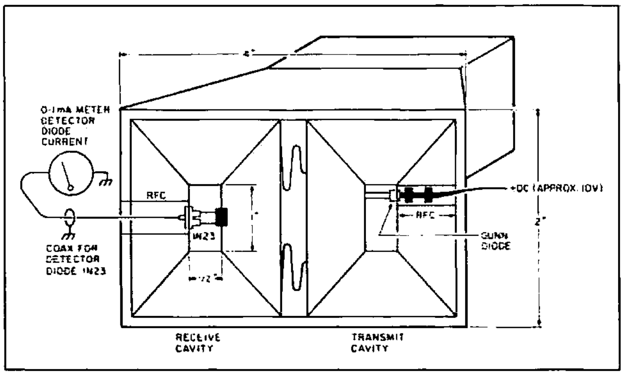

Figure 1. 10 GHz dual cavity from AA6EG. Each cavity couples to its own horn antenna. Antenna gain is 10–12 dB.

Steve KA0ZIL goes on to say that with two units, he will probably rope Rusty N0HVW, a good friend, into 10 GHz operation. Figure 2 is a sketch Steve provided of one of his units. This unit is very similar to the SOLFAN devices. Power to the Gunn diode is positive.

With 5 volts positive on the Gunn, Steve was able to measure about 1 mA on the detector diode. A little much, but still OK for a transceiver. Connecting the detector to a monitor receiver, Pat was able to detect his finger movement In front of the cavity while monitoring on the receiver. For a Doppler radar device, connect your detector diode to a small audio amplifier. The low frequency sound you hear is the microwave Doppler signals returning. As a matter of fact, the radar devices the police use are very similar. They have circuits that measure only the low frequency audio tone (Doppler) to indicate your speed. It's a direct correlation. For a speed of about 35 miles per hour, the audio Doppler returned is about 1085 Hertz. This works out to about 31 Hertz per mile per hour.

Setting the Frequency

The biggest problem remaining is to set the frequency so that your operation is within our amateur bands. I have received letters from several amateurs without test equipment, who are trying to set the frequency. Without test equipment, it can be quite bothersome. I am willing to set up cavities sent to me in the mail (provided return postage is included) to the frequency desired, and I will provide a voltage vs. frequency spread calibration chart for the unit. Ron Wicker WA5VJS has taken me up on this offer and shipped me two SOLFAN units.

I set both units on 10.250 GHz with my HP counter. It remains to be seen just how much bouncing around the units will take for a change in frequency in the postal system. They were well-packed and should survive. Postage cost less than I'd anticipated, at $2 for a one-pound package. The rates go up very quickly for a package over two pounds.

The Injector, described in the January 1989 issue of *73 Magazine*, is an alternative to verifying frequency. Take a detector mount and replace the normal detector (1N23 diode) with a surplus varactor and a 3 dB pad for DC return. Inject your 2 meter HT on low power (100 mW) in to the mount. The varactor should produce energy radiating on 10 GHz. 146 MHz times the 70th harmonic = 10.220 GHz, a good marker. Experiment with surplus varactors for best results on output. It will be very low power, and close coupling is needed, but it works well.

So. Cal. Microwave Weekend News

There was quite a flurry of microwave activity on 10 GHz narrow band FM and SSB here in southern California over our most recent microwave weekend. The contacts were from a location in the Lake Arrowhead, San Bernardino mountains at Heaps Peak. Phil W6HCC was operating his 10 GHz system with about 1 Watt of power output, and had a very noticeable signal. You could turn your antenna some 20 degrees away from the true path and still copy him at a distance of over 100 miles with no trouble.

There were several other stations operating remote to Phil W6HCC at Heaps Peak. Chuck WA6EXV was operating in the desert to the east checking out locations. Kerry N6IZW, Ed W6OYJ, Art WA6OYS, and Leon WA5BNH from the San Diego Microwave Group were operating on Mt. Soledad in San Diego proper, anchoring the southern end of the 100 mile test path.

The signals from W6HCC's rig with 1 Watt output were so strong they were pinning the S-meter on the narrow band systems at Mt. Soledad, 153 km distant. Kerry N6IZW made contacts with both FM and SSB over the 10 GHz path to Heaps with relative ease. His system uses a two stage MGF-1402 preamp with about 18 dB gain and 4 dB noise figure. Provisions are made in N6IZW's rig to reverse the amplifier and use it in the transmit mode, as it is linear

and gets about +5 dBm output on transmit (approximately 3 mW power). The S-meter indicated full peg on both SSB and FM.

Leon WA5BNH was using his system which places the mixer directly on the antenna without a preamp. His output power (transmit) is about 100 µW. Leon was able to make contact with Phil W6HCC on Heaps Peak who was still full peg on WA5BNH's rig. W6HCC decided to reduce his power to about 100 mW, and Leon WA5BNH saw the S-meter come just off the peg. Further reducing W6HCC's power to 20 mW gave WA5BNH's S-meter an S-7. The copy at Heaps was just above marginal during the test, using 5 kHz FM for the contact on 2 meter HTs.

Kerry decided to try another test. He replaced the 2 meter FM transceiver with a Santec LS-202 multimode 2 meter HT capable of FM and SSB with the same transmitter power. He switched the mode to SSB on both ends of the path. The resulting copy went to full Q-5 copy on SSB at Phil W6HCC's location. Going back to FM again led to marginal copy. It's often very handy to be able to switch to SSB from FM to improve copy on a long path.

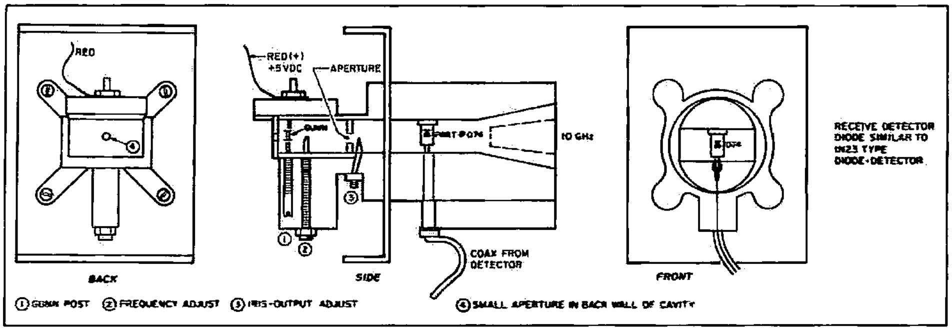

Figure 2. KA0ZIL's 10 GHz unit. With 5 V to ground, the detector diode gives about 1 mA DC.

Equipment Detail

A brief outline of the equipment is in order so that you can see just what is pieced together. The parts are not all identical, and they depend on what is available through scrounging or swap meets. The heart of the unit is the phase-locked oscillator that provides about +10 to +20 dBm output on 10 GHz. The units that we have been able to obtain have come from many different sources. The prime source seems to be the surplus disposal section at Collins Microwave in Richardson, Texas. They hold monthly auctions to dispose of out-of-spec equipment, and the hams in that area pick up the material and make it available through newsletters and swap fests.

The phase-locked oscillator is basically a high power microwave oscillator running in the 1.2 to 2 GHz range, depending on the model. You tune it with a varactor controlled by a 97 to 100 MHz crystal reference. Some crystal oscillators are internal and some are external. The internal types usually demand a higher price, about $35 to $50 dollars each, depending on condition. The less desirable units run about 5 to 10 dollars less. In future columns I will describe fully the microwave "brick" oscillators as well as the preamps used, and the relay switching techniques needed to place a system of your own in use.

Let's Hear From You!

I would be glad to answer any questions concerning VHF/UHF and microwave operations. Please send a self-addressed stamped envelope for a prompt reply. I will include some of your letters in future columns to assist others who are having the same problem. Send all questions to me at the above address. 73s and see you next month!

Keyword Index

Number 22 on your Feedback card

Issue #345

Number 23 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D. WA3AJR
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Baltimore MD 21208

Well, I heard you. With the responses to the March 1989 RTTY Loop Reader Survey pouring in (I mean it—you really *did* respond to this one!), many of you made one thing quite clear. You are anxious to anger your spouse, parent, or significant other and burn little holes in the kitchen table with a construction project or two. Glad to oblige.

The most-asked-for items by far were small, one- or two-chip, or transistor projects useful to the RTTYer, new or old. Simple demodulators and AFSK units led the pack, with other types of test or interfacing circuitry following. With these requests ringing in my ears, let's see what I can muster up.

The TU, Demodulator, and Modem

Receiving RTTY is the first item of business, and that requires a terminal unit of some kind. Early in this hobby, the device that decoded the bloodle-bleeps of RTTY into the clunky-chunks of TTY was called a "Terminal Unit," probably because it was the electronic unit used at the terminal. Commonly abbreviated TU, this term is still quite widely used. A bit later, the moniker "demodulator" surfaced, derived from the demodulation of frequency shift keying into TTY loop voltages. We also still hear the phrase "truncate to demod." Recently, an interface that both sends and receives, modulates and demodulates so to speak, is called a "modem," from the initial syllables of these two words. Originally a computer term, it has crept into our vocabulary as well.

However you wish to call it, our goal is to make a simple device which will convert frequency-shifted audio tones into a keyed voltage. The heart of this circuit is a demodulator on a chip, the XR-2211 phase-locked loop demodulator. Although not in the latest Radio Shack catalog, it used to be carried on their parts wall, and it may be in the clearance bin at many stores. If not, Radio Shack dealers can order one for you. Also, you can buy it at many parts stores and by mail order; the Jim-Paks line carries it.

All other components in this project are common parts. You can buy them at Radio Shack or other parts houses. I recommend building the device on a small piece of perf board, with point-to-point wiring. Clubs may wish to etch a circuit board; this could be a useful introductory project.

The Demodulator

Now, to the matter at hand. Figure 1 is a schematic diagram of the demodulator. The audio output of your receiver, either HF or VHF, is coupled to the demodulator through a 0.1 µF capacitor to pin 2 of the XR-2211. With no input filtering on this device, it is important to present a clean signal, either a good VHF RTTY signal or a strong, interference-free HF signal.

A phase-locked loop (PLL) demodulator is normally tuned for the frequency and bandwidth desired. Here, the 0.022 µF capacitor from pin 13 to pin 14 of the integrated circuit and the 20 k resistor (an 18 k fixed and 5 k variable) on pin 12 set the center frequency to about 2125 Hz, midway between a 2025 Hz mark and 2225 Hz space frequency.

Set the bandwidth to allow 300 baud transmission with the 200 k resistor between pins 11 and 12. The filter of the 0.005 µF capacitor and 100 k resistor coming from pin 8 provide additional trimming.

Naturally, with a circuit operating at TTL levels, the output from this one-chip wonder is at TTL levels. Don't try to drive a Model 15 with it—at least, not directly. Future columns will include some interfacing schemes that will let you do this.

Apple News

In the March issue of RTTY Loop, I mentioned Byron Schulten's Apple woes, but somewhere between my data transmission and the typesetter, his computer mutated from an Apple IIgs to an Apple IIe. Well, Bruce Klutchko, M.D. WB2HLX, Hastings-on-Hudson, New York, offers his advice regarding a piece of software called MODEM MGR. Bruce says that he has used this program for several years, and has found it one of the most comprehensive and well-supported programs available for the Apple II+, IIc, IIe, or IIgs. It supports split-screen operation or full screen at speeds to more than 19KB, and it will run under either ProDOS or Apple DOS 3.3.

Bruce notes that Apple users sometimes feel orphaned by the amateur industry, but they're reluctant to give up their machines. He feels that MODEM MGR speaks to that need precisely. It is available from *MGR Software, Suite 101, 305 So. State College Blvd, Anaheim CA 92806.* Contact them for current pricing and availability, and be sure to mention *73's* RTTY Loop when you write.

Next—Transmitting

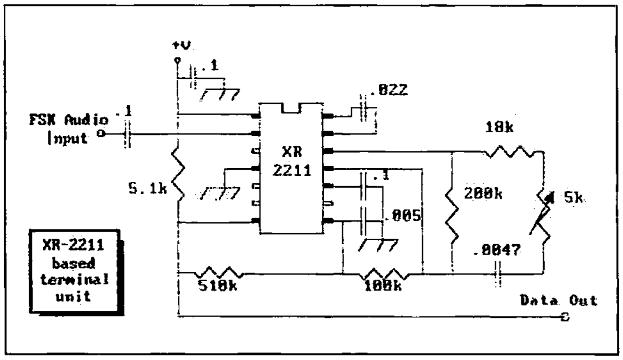
Next, we'll cover the other side, transmitting, with a one-chip RTTY modulator. As always, I welcome your questions and comments, either by mail or E-mail. Send paper to the above address, E-mail to me on CompuServe (75036,2501) or Delphi (MARCWA3AJR) with your comments, questions, suggestions, or criticism. All of it is appreciated. ■

"MODEM MGR . . . supports split-screen operation or full screen at speeds to more than 19KB, and it will run under either ProDOS or Apple DOS 3.3."

Demodulator Parts List

Integrated Circuit	XR-2211	Jim-Paks or mail order	
***Resistors**	510Ω	RS 271-1330	5/$0.39
¼ or ½ Watt	18000Ω	RS 271-1337	5/$0.39
	100kΩ	RS 271-1347	5/$0.39
	200kΩ	RS 271-1350	5/$0.39
	510kΩ	RS 271-1354	5/$0.39
Potentiometer Miniature PC mount	5000Ω	RS 271-217	$0.69
Capacitors	0.022 µF	RS 272-1066	2/$0.69
Precision disk	0.005 µF	RS 272-130	2/$0.49
	0.0047 µF	RS 272-130	2/$0.40
	0.1 µF x 3	RS 272-135	2/$0.59
Perf board	0.1″ grid	RS 276-1394	$1.99

*Resistor values are nominally within 10%. For all practical purposes, the available Radio Shack values are close enough for this project to the specified values. If you can get exact values, fine. If not, don't lose any sleep over it.



ASK KABOOM

The Tech Answer Man

Michael Geier KB1UM
7 Simpson Court
S. Burlington VT 05403

Fix or Ship?

Previous columns covered how to fix your radios—an important part of the ham experience. There comes a time, however, when it makes sense to send the rig back to the factory, even if you are a very skilled technician, and especially if you're not. This column is about determining the cutoff point between "I can fix this!" and "Where's the shipping box?"

Technical Skill

One very important factor is your confidence in your ability to repair your rig. With the cost and complexity of today's rigs, you don't want to get in over your head and make mistakes that can result in tremendous repair bills later. This ability varies widely among hams, and seems unrelated to class of license. Some hams are just more into the mechanics of the technology than others.

Manufacturers discourage owner-performed repairs, and it makes good economic sense for them to do so. For one thing, they make money when you send the rig in, unless it's under warranty. Also, they maximize their profit by fixing the most units per day possible. If a technician has to spend several hours wading through an owner's botched repair job, the company makes less than it would if he could fix several units during that time. The problem is compounded by the fact that the tech often has no idea how to separate the original problem from what the owner has done to the rig!

Warranty Service

Warranty service from manufacturers can be very slow—you wait up to several months to get your radio back. This makes it tempting to fix it yourself, but it just doesn't make sense to open up your rig while it's still under warranty. If you tamper with it and then have to send it in anyway, it will automatically be classified as "out of warranty." You will be charged the regular rate, even if your intrusion is unrelated to the malfunction.

This doesn't apply, of course, to the installation of factory options, such as filters, FM boards, and the like. The basic purpose of warranty service is to correct "infant mortality," or the sudden malfunction of a new product. It is axiomatic, and true, that a solid state device will tend to either die within a week, or work for years. Hence the standard 90-day warranty. Although the trend is toward longer warranties, they are a pretty safe bet on the part of the companies. So are extended service contracts.

Fixing vs Tweaking

One thing I've found about warranty service is that it's just about impossible to get a radio adjusted unless it is so far out of whack that it's practically unusable. As far as manufacturers are concerned, it either works or it doesn't. So, if you are unhappy with, say, the alignment of an oscillator frequency, live with it until the warranty runs out, and then adjust it yourself.

> **"a new solid state device will tend to either die within a week, or work for years."**

The Big Decision

Now the rig is out of warranty, and it stops working. What to do?

The basic strategy is this: Weigh the chances of a successful repair against those of making things worse. This does not have to be a purely emotional gut reaction. You can approach it in a logical manner.

First, ask yourself whether you have an idea about what is wrong with the darned thing! Sometimes the problem will be obvious to you, and other times it will be a big mystery. Even if it's a mystery, you can still tackle it yourself, as long as you feel competent to do so.

Next, ask yourself whether you have the equipment to do the job. The first order of business here is a schematic diagram. To delve into the rig without one is just asking for major trouble. Look at your test gear. If you suspect a power supply malfunction, perhaps a VOM will do, but do you really want to dive into a PLL problem without a scope?

Finally, weigh your time versus the expected repair costs. A job that will take you 14 hours to puzzle through, but may only cost $60 at the shop, is probably not worth doing, unless you have lots of free time (free what??), or you just want to play with it on weekends, in which case it will probably sit broken even longer than it would at the service center!

Getting Parts

They say that in Australia, parts are plentiful because there are lots of electronics enthusiasts. That's certainly not the case here in the good old U.S.A. Chances are that you'll wind up having to order parts from the manufacturer. Expect to get soaked. I was recently charged $11.70 for a chip that should have cost no more than $3.00! Manufacturers mark up parts very heavily. (An exception is Yaesu. Parts I've ordered from them have been very reasonable.) In any event, at least the labor (yours) is free!

Now, let's look at this month's letters:

Dear Kaboom,

Why does the last digit on the frequency display of my TS-130S sometimes drift up and down, while my friend's TS-440S is absolutely stable? Is there some way I can make mine stay put?

Signed,
Wanderin'

Dear Wanderin,'

The answer lies in the fundamental difference between the two radios. The older '130 has an analog VFO, and the display is a type of frequency counter. As the VFO and/or counter drift, the number wanders. The '440, however, is a digitally synthesized rig. The display is generated by the microprocessor, and has nothing directly to do with the actual frequency of the radio. The computer also controls the synthesizer to put the radio on the displayed frequency. In other words, the TS-130's display follows the radio, and the TS-440 works the other way around.

Dear Kaboom,

The middle segments of all the numbers in the digital display on my Kenwood TS-120S have gone out. Otherwise, the radio works fine. But it sure is hard to tell what frequency I'm on; the numbers look like something from another planet! Where should I look?

Signed,
Half-Digit

Dear Half,

The likely culprit is the TC5066BP, IC16 on the counter board. This chip is a display-tube driver, and it controls the middle segment. The part is available from Kenwood. The board is just behind the display. Be careful not to break the delicate display tube when you pull the assembly to change the chip.

Dear Kaboom,

I have a modern digital HF rig, and when I tune through the bands, there's an annoying thump in the audio every 10 kHz. It's especially noticeable on AM signals. I called the company, and they said it was normal, but my cousin's identical model doesn't do it, and his is two years older! Are they lying to me or what?

Signed,
Thumper

Dear Thumper,

No, they're not. If you've been reading ham mags in the last year or two, then you've read about phase noise in synthesized rigs. It's a sort of modulation of the oscillators, caused by the digital control process. It degrades a radio's performance, and the manufacturers have been trying to improve the situation. The current fix is to make the phase locked loop tighter by decreasing the loop filtering, and it works.

Unfortunately, it also causes some overshoot at certain frequency intervals, and this is what causes the audio thump. Your cousin's unit was made before the mods went into effect.

Have a tech question? Send it off to "Dear Kaboom" at the above address.

Number 25 on your Feedback card

QRP

Low Power Operation

Mike Bryce WB8VGE
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Photo A. Some of the projects that didn't quite make it...

Building one's equipment is a lot of fun—great fun, in fact. On the other hand, it sure is no picnic when you're all done, and then nothing happens. So, we'll take a close look at getting that dead radio to fly with some simple troubleshooting technique.

Before you start to construct any project, give the schematic a good look over. You will occasionally discover errors and, somewhat more often, important omissions in product documentation and magazines. Look over the schematic for proper Vcc connections, ground points, input/outputs, and other important details. In many cases, the Vcc pins are not marked in schematics, assuming that everyone knows that pin 14 of a 4011 chip is Vcc and pin 7 is ground. Of course if you don't know that, and you don't connect the pins to the proper points, the circuit just won't work! Aside from that, there are zillions of reasons for a non-working project. Let's take a look at several of those reasons this month.

The Approach

Other than looking for errors in the schematics and wiring, what do you do? Break the problem down into small bite size pieces. You'll need some rather simple test gear, including a good quality VOM, either an analog or digital model. You'll also need a logic probe for those digital projects, and a variable power supply. The supply should sport a current meter.

Now for the troubleshooting. First things first. Just what is the project doing? Or not doing? Just because the transmitter has no output doesn't necessarily mean the circuit is totally dead. Let's connect our small transmitter to the power supply. With the ammeter monitoring the current being drawn, we can get a reasonably clear picture of what is going on. After you power up, what kind of current do you see flowing? Depending on the type of circuit you're working on, you should see some current being drawn by the oscillator(s). Key the transmitter. Does the current go up? If not, then either you're not applying a key voltage to the PA, or the PA transistor is defective. Remember, most failures occur because of heat. The PA transistor and the power supply pass transistors generate heat, so you should watch those parts. If you don't see any current being drawn by the circuit, check for Vcc on the oscillator.

What do you do if your dead project has a self-contained power supply? Well, don't laugh, but be sure that it's plugged into a live outlet. Check for the proper voltage coming out of the power supply. Look for internal fuses. Some transformers use a fused primary wire inside the transformer. When these go, you can't fix them, short of replacing the defective unit.

Another common problem with power supplies is that there may be steering diodes used for battery/AC operation. Check these diodes with your VOM.

Without the oscillator, you'll not get a microwatt of power out. You can check for proper oscillator operation with either an RF probe or a general coverage receiver. I use a frequency counter on my bench. A small two or three loop pickup coil will sniff out the RF. I won't get into PLLs. They can cause a lot of trouble and are beyond the scope of this column. In troubleshooting most simple two or three transistor QRP transmitters, check the oscillator first. Next, check for output of the oscillator. A coupling capacitor may be at fault. From the oscillator, check for output at the buffer transistor (if used). If all is as it should be, but there's still no output showing at the antenna, check for Vcc on the PA transistor.

Now check the output coupling capacitor. Capacitors rarely go bad, but sometimes you pick out a dud from the junk box. An out-of-tolerance capacitor can cause you a lot of fuss.

Next in line to look at is the transmitter. Does it use TR/switching? If so, check the diodes. A shorted diode will cause the output to come up zero. In this case, monitor the current meter on the power supply. It should show normal current, perhaps even draw more current than it should. If that is the case, check the output section for a short. You can use your VOM to find a DC short, but not an RF short caused by a capacitor breaking down under the presence of RF. In this case, use a WCF. A WCF? Yup, a Well Calibrated Fingertip.

Happy, healthy capacitors don't get hot during operation. With your fingertip, check the output capacitors. (With the power off! No RF burns, please.) If you find a warm capacitor, replace it. I also use this technique when troubleshooting computer mother boards. All those 0.1 µF caps on each chip. It has saved me a lot of time. Take care, however, to ground yourself when using this method when working around components such as CMOS chips. Static electricity can kill these components.

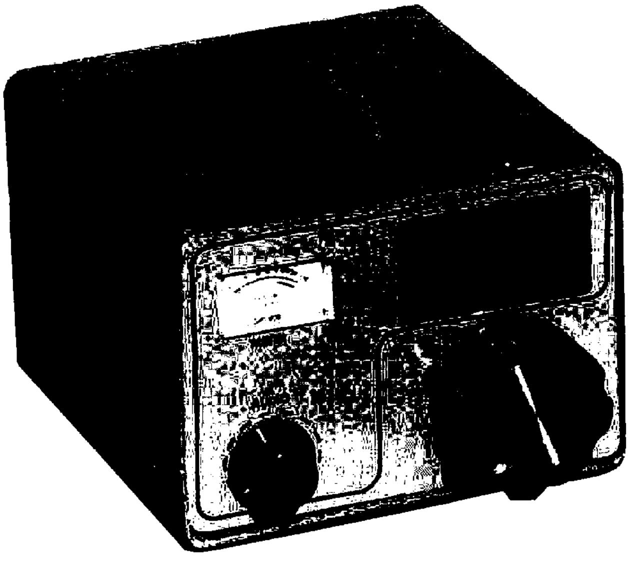


Photo B. A little home-brew unit that sports a VMOS power amp and a direct conversion receiver.

After you get some troubleshooting time under your belt, the WCF will save you a lot of grief. PA transistors, audio power amplifiers, and other heat producing devices all run warm. You can tell just how well the device is doing just by the amount of heat it generates. Regulator ICs should be warm. If not, then the circuit is not drawing much current, or none at all. If the regulator is steaming hot, too much current is being drawn.

After exhausting all the easy-to-fix problems, we have to look a bit deeper into the circuit. I've always had a hard time with fixing a radio that I did not build. However, I've had some luck by having someone look over my work. Sometimes, after spending hours and hours looking over a circuit, you just can't see the problem. A friend can sometimes pick out the trouble in a few seconds!

continued on p. 80

Number 26 on your Feedback card

NEW PRODUCTS

Compiled by Linda Reneau

PRODUCT OF THE MONTH

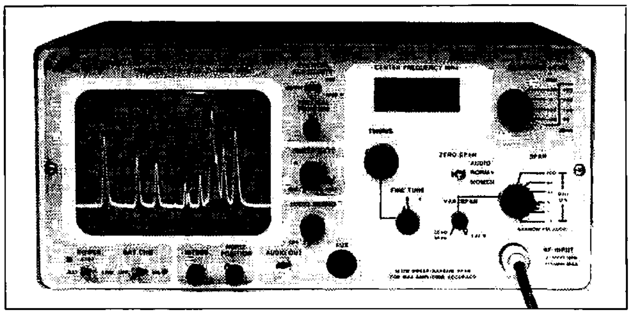
MODEL CCB RF DETECTOR

The hand-held Model CCB RF Detector from Optoelectronics will indicate the presence of a 1 mW transmitter within a twenty-foot distance. The bargraph display successively illuminates up to 10 segments as the distance to the transmitter decreases. This simplifies locating and deactivating the unauthorized transmitters, or "bugs," placed in rooms for listening to private conversations.

Other applications include checking the output from small or large transmitters used in radio telemetry, two-way radio, ham radio, garage door openers, RC transmitters, cordless and cellular phones, marine and aircraft radio, CB, police and emergency radio services.

The CCB has a two-stage wideband RF amplifier, and a forward biased hot carrier diode for a detector. The output of the detector is filtered and fed to the log output bargraph driver circuit. Each segment responds to a 3 dB step increase in signal strength. Screwdriver adjustable pots are provided for zero and full-scale adjustment.

The CCB RF Dectector is $100. *Optoelectronics, Inc., 5821 N.E. 14th Avenue, Fort Lauderdale FL 33334. (800) 327-5912 or (305) 771-2051.* Accessories include the Model TA-100S telescoping BNC antenna for $12 and the CC-12 vinyl zippered case for $10. Circle Reader Service Number 201.



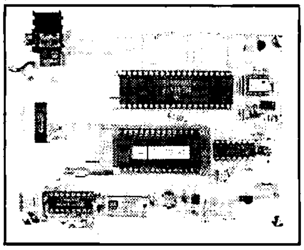
AVCOM

Avcom introduces a new portable spectrum analyzer, the model PSA-65A, which covers frequencies through 1000 MHz in one sweep with a sensitivity greater than −90 dBm at narrow spans. The light-weight PSA-65A, battery or line powered, was designed for 2-way radio, cellular, cable, LAN, surveillance, educational, production, and research and development work.

Options include frequency extenders for Satcom and higher frequencies, audio demod for monitoring, log periodic antennas, carrying case (AVSAC), and more.

Size—11½w x 5½h x 13½d; weight—18 lbs./8.18 Kg. Price, $2,675. Request brochure and spec sheet. *AVCOM of VA, Inc., 500 Southlake Blvd., Richmond VA 23236. (804) 794-2500. FAX: (804) 794-8284. TLX: 70-1545 AVCOM.UD.* Circle Reader Service Number 208.

ELKTRONICS

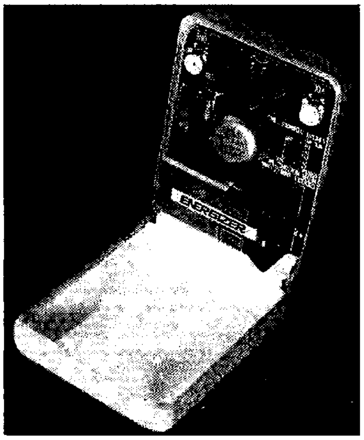


The Elktronics Video I.D. Board (VDG-1) provides a quick source of instant video especially useful for those active in ATV or SSTV. Four computer graphics screens (2 Hi-res/2 color bar) come on a custom-programmed EPROM with your callsign.

Since the VDG-1 operates from 12 volts DC, and measures just 3.75" x 5", it's ideal for ATV repeater identification or portable and mobile operation.

You can switch from the I.D. to live camera. An automatic timer/sequencer allows you to display all four graphics screens in various combinations. Price, $89. *Elktronics, 12536 T.R. 77, Findlay OH 45840. (419) 422-8206.* Circle Reader Service Number 210.

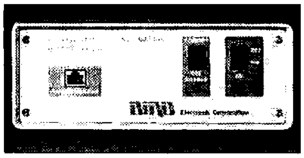
MEDIA MENTOR, INC.



The Codekey 1000 is a custom-made Code Practice Oscillator from Media Mentor, Inc. It is a practical, cost-efficient classroom tool for motivating children to enjoy practicing Morse Code. The Code Key Oscillator operates on a standard 9-volt battery, which is included in the price of $19.95.

Youngsters will love the hands-on experience of operating their own keys. Every child will want to have her and his own. This is a great fund-raising item for a school.

Call Carole WB2MGP's *Ham Radio Hotline* for information on this and other instructional products. *Media Mentor, Inc., PO Box 131646, Staten Island NY 10313-0006. (718) 983-1416.* Circle Reader Service Number 207.



BIRD ELECTRONIC CORPORATION

Bird Electronic's new model 4029 Power Sensor Calibrator was designed for use with its 4420-series RF Power Meters. In conjunction with a CRT or PC with a serial port, it provides in-field calibration of the power meters to within ±3% of a known RF standard.

A menu guides you through the calibration process. You connect the calibrator to a 4020-series RF Power Sensor, and drive it with a known amount of RF power at a specific frequency. You enter the power level, and the calibrator automatically calculates and stores a correction factor in the Power Sensor's memory for that frequency. Since calibration data is stored in the Sensor, rather than in the display unit, you can use any 4020-series Sensor, with any 4420-series Power Meter, with no degradation of accuracy.

The 4029 can add, delete, clear, and list calibration points for review. The unit also checks the validity of operator input and warns of incorrect responses. The calibrator comes with connectors for a standard 25-pin serial cable and the Power Sensor cable. Voltage is 115/230 volts AC, 50/60 Hz. Price, $1750. *Bird Electronic Corporation, 30303 Aurora Rd., Cleveland OH 44139. (216) 248-1200.* Circle Reader Service Number 202.

continued from p. 76

All of us have at least slightly different perspectives on these things.

If you're working on a home-brew project and can't seem to get it to operate quite right, drop a line to the author. There may be a spider or two that got into the article. If you do write, please, by all means, send an SASE for your reply. I know from first-hand experience that those who send an SASE will get a reply quicker than those who don't. In your home-brew project, again, look everything over closely. Be especially picky about the proper pinouts of transistors, ICs, and other active devices. Next, check for the proper polarity of the electrolytic capacitors. Those critters just don't work if they're installed backwards. Look over the values of the resistors. It's so easy to transpose a 1kΩ resistor for a 10kΩ resistor at 2 o'clock in the morning.

To Tweak or Not To Tweak

If you're working on a commercial product, whatever you do, don't get out the diddle sticks and start messing with the alignment! I've never seen a piece of equipment stop working because the alignment went bad, unless someone diddled with it first. Don't diddle unless you really know what you're doing. There is one exception—Heathkit gear. If you can't seem to get one working as it should, then do an alignment. Most Heathkits can be aligned with simple tools, sometimes using nothing but the radio itself. You can sometimes pinpoint trouble by going through the alignment on Heath gear. Finding a stage that will not peak up as it should will give you a starting point for more serious troubleshooting. But again, don't diddle with the alignment of non-Heath gear. We'll look at some more troubleshooting guides later on this year.

". . . most failures occur because of heat."

Ten-Tec Mod

I want to thank all of those who sent me information on converting the Ten-Tec Century 21 for 12 volt operation. For all those who wrote in to me, thanks! For the rest of the gang, here is the modification for 12 volt operation.

First, you'll need a magnetic circuit breaker for the 21. This is Ten-Tec part number 1170. Since the protective circuitry for the PA transistors in the Century 21 is included in the internal power supply, you *must* use the circuit breaker when running the 21 from 12 volts. After you obtain the magnetic breaker, apply 12 volts to the 21 via one of the AUX 12 VDC phono jacks on the rear apron of the Century 21.

Doing this, however, makes the front panel wattmeter inactive (while on external 12 volts only). To adjust for full power, turn up the drive until the breaker trips, reduce the drive a tad, and reset the circuit breaker. You're all set to fly this month for Field Day!

Speaking of Field Day, I sure hope that you guys send in some photos this year. It's been slim input from the QRP operators on the subject of Field Day. Sure could use some good photos. If you like what you see, then by all means drop a line to the editors.

For those of you who just can't get enough solder smoke in your face, I've got some modifications to the Two-Fer. These modifications are by Don Garrett WA9TGT. The mods make for better output filtering, full QSK, automatic antenna switching, high SWR protection, and power output adjustment. The 12 volt line on the oscillator has been moved to the collector of Q4.

This keys the oscillator along with the PA and buffer amplifier. Since there is not enough room this month for the mods, those wishing to get a copy should send me an SASE. I'll send you out two data sheets for the modifications. No SASE, no data!

Don't forget Field Day this month. Watch for openings on ten meters. Should prove to be a lot of fun!

ADVERTISERS

Number 27 on your Feedback card

*Advertisers who have contributed to the National Industry Advisory Committee (NIAC).

LOOKING WEST

Bill Pasternak WA6ITF
28197 Robin Ave.
Saugus CA 91350

Barry Goldwater Says YES to No-Code!

"I'll make a prophesy, and I won't be alive to ever see it come true. If we continue to require a knowledge of code for an [amateur] license, people are going to just plain die! I'm 80, and I know I'm not going to be around here forever, and when I'm gone, that's one less guy who knows the code, so what's the difference. I don't want to see amateur radio die out because, as I have said, 98% of all of the improvements made in radio have come out of an amateur's shack. I want to see that encouraged. I think we can swell our ranks by at least 200,000 if we just allow young would-be amateurs to come in as licensed amateurs without having gone through the process of learning Morse Code!"

With these words, former US Senator Barry M. Goldwater K7UGA threw his hat into the amateur radio political arena on the side of those who favor expansion of the amateur service through the introduction of a code-free entry level amateur license. Senator Goldwater made those comments in a videotaped interview record at his Scottsdale, Arizona, ranch on Saturday, February 25, to newsman Roy Neal K6DUE, producer Frosty Oden N6ENV, and Newsline Radio's Bill Pasternak WA6ITF.

Needed: New Blood

During the same session, K7UGA said that he did not think that the amateur community could hold onto the majority of the spectrum it has, particularly at VHF and UHF, without substantial growth. "Can they [the amateurs] hold onto it with the numbers they now have? It's very doubtful. Can you hold onto them with a couple hundred thousand young amateurs? Yes!"

K7UGA went on to give his view that experimentation and building in amateur radio may be a dead issue with many of today's hams, but it can be revived by getting younger people interested in the service: ". . . We have got to get some new blood. We have to get the new ones who will sit down with a screwdriver and soldering iron and a manual, and build something. When they [younger hams] hear of some new method of communications, they [will] sound like they know something about it. . . You ask the average ham our age-or my age, because I'm a hell of a lot older then you-to describe some of these new signals, and they can't do it."

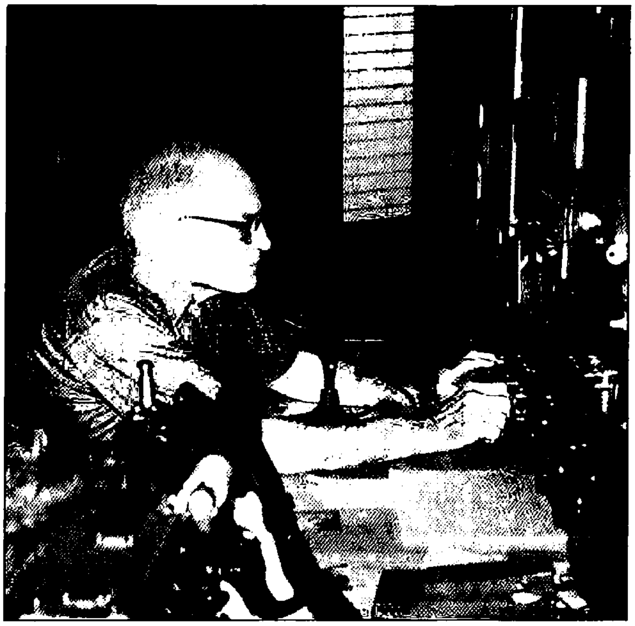
Partly Politics

Senator Goldwater says that the American Radio Relay League, publications, and industry, must take an active roll in leading amateur radio to new times through a no-code amateur license: ". . . you first have to get the ARRL behind it. You have to get these magazine editors-who I think are inclining that way. And [talking to the amateur radio industry] you have got to remember one thing, if you have more amateurs, you are going to sell more equipment.

"You have the same problem in anything that touches on politics. . . The easiest way [to grow] is to convince the American Radio Relay League that, opposition or no opposition, if they want to increase the amateur ranks, they have to do away with the number one objection—code."

Pass it Along

The complete program was uplinked to the WESTSTAR 5 Communications Satellite (122.5 Degrees West) on Sunday afternoon, March 12 at 3 PM Eastern/Noon Pacific. It appeared on transponder 1D (1 Direct—Horizontal Polarization). Amateurs with satellite receivers and VCRs who recorded the program are encouraged to replay it at their regular club meetings, and use it to help formulate their opinion on these issues. As no music was on the presentation, it's suitable for live or delayed retransmission on ATV systems. You can also replay the audio on your local repeater. *Newsline Radio* and the *BEAR Information Service* provided the audio portion of the Goldwater conference by dial-in telephone after it aired. 73



Barry Goldwater K7UGA, an elder statesman of amateur radio and veteran CW op, during his statement of support for a no-code entry-level license.

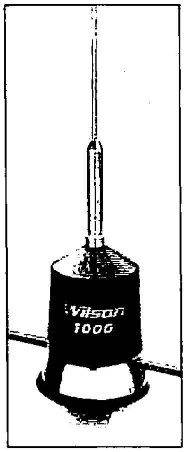
Number 29 on your Feedback card

73 Review

by Marc Stern N1BLH

Wilson 1000 Mobile Antenna

Wilson Antenna
2 Commerce Center
Henderson NV 89014
(800) 541-6116
Price Class: $90



Get into some 10m mobile QRO with this whip.

Now that we are nearing the peak of what promises to be the best solar activity in history, many operators are discovering the fun of the 10 meter band. It's a band which combines the attributes of HF and VHF, and offers lots of prime DX. With such recommendations, is it any wonder that 10 meter rigs are selling like hot cakes, and that Novices are on the air using their phone privileges?

10 Meter Antennas

One of the more interesting aspects of 10 meters is the antenna. There are so many possibilities that it can boggle your mind. For example, you can convert a 109-inch CB whip to 10 meters (11 meter CB to 10 meter Ham), you can convert one of the many magnetic-mount or shortened 10 meter antennas, or you can buy a 10 meter antenna made specifically for the band.

One of the better 10 meter antennas that we've found lately is the new Wilson 1000. Wilson, long a manufacturer of quality communications antennas, is a name that many will remember fondly as one of the pioneering firms in VHF communications. Although Wilson has been out of the radio manufacturing business for a few years, it has remained in the antenna business. The firm's long experience shows up in the 1000.

For starters, it just doesn't look like other 10 meter antennas on the market. Maybe it's the big base loading coil, or the 60-inch-plus tapered 17-7 steel radiator or, maybe, it's the PL-259 connector in the base of the antenna. Who knows? All we do know is that the antenna works very well. In a comparison test with the American Antenna HAM-10, we found that the 1000 performed as well as or better than the HAM-10, and was far less prone to noise pickup. (The test setup was: a clear parking lot; our car; Uniden HR-2510 and Clear Channel AR-3500; and a field-strength meter.) Using an attenuator, we cranked the power back to about one Watt and tested the antennas. The results were interesting—the Wilson performed better, especially toward the lower end of the band.

That is one of the interesting points about the Wilson 1000: It arrives set up to work in the lower end of the band. We still found the VSWR too high for our liking, and trimmed the radiator about 5 inches to make sure that the antenna was resonant. It is fairly flat across the entire band, although the VSWR does climb at the high end, near 29.600 MHz.

On the air, QSOs confirm the point that the Wilson 1000 is a fine performer, on a par with full quarter-wave mobile whips. It is a loaded antenna, which effectively increases the Q of the antenna circuit and limits its bandwidth.

To keep these losses to a minimum, Wilson uses quality constructions techniques, including a wide base loading coil that is made out of 10 gauge, silver-plated wire. The tap point is determined by a computer. The antenna is made of a quality, high impact plastic, and the connectors are standard PL-259/SO-239, which should assure a tight fit and years of use.

Remember, if you are thinking of this antenna, that such quality construction doesn't come cheap. At $89.95, the Wilson 1000 is not inexpensive. However, given its construction and performance, it's a purchase worth considering. 73

LETTERS

From the Hamshack

Let's Petition the FCC

At my place of employment, where an FCC commercial license (2nd Class/General) is required, less than 10 in a department of more than 200 employees are licensed amateur radio operators, though many expressed an interest in the hobby. At my former place of employment in the Telecommunications Dept., there were only two licensed people, though again, many were interested in ham radio. Why, in a nation with millions of electronic technicians, engineers, and computer hobbyists, are so few willing to go even for Novice?

The nail in the coffin is the code requirement. If anyone is to be blamed for the lack of public interest in amateur radio, the blame must rest on the ARRL. It has been spoon-feeding its members the propaganda that if the FCC created a no-code license, the ham bands would end up like CB. But many nations do not require code in order to obtain a VHF/UHF license, and this has not happened there. In these other nations, a large percentage of the licensed amateur operators are engineers and electronic technicians.

I propose that we (1) petition the FCC for the creation of a no-code VHF license (Technician class) which would allow transmission of SSB/AM/FM/Digital on one or more VHF/UHF bands.

Joe Hill KO7P
S. Pasadena CA

Joe, thoughtful no-code license petitions are already appearing at the FCC's doorstep. See the first item in QRX for a summary of one of these... NS1B

Yes to Code

I'm writing in response to all of the articles on no-code. In my opinion there should be a code requirement in all cases. Some say the code test is too narrow of a filter. I believe on the other hand the written test is too wide of a filter. Anyone can memorize the questions and answers.

Some say if we don't increase our numbers we will lose more spectrum. Even if we increase our numbers to a million, that's still less than half of a percent of the US population, and no competition for back-slapping lobbyists and corrupt politicians. I'd rather have minimum spectrum and people who are dedicated to the hobby than mega-frequency allotment and chaos.

James S. Smith KA6MLE
Morro Bay CA

Not the First!

On page 24 of the April 1989 issue of *73*, you ran a picture of the Kenwood TM-621A with the caption "... The world's first 2m/220 MHz dual band mobile rig in a single box...." This is incorrect!

In 1975 I worked as a circuit board assembler for Comcraft Corporation of Goleta, California, building the Comcraft CST-50. The CST-50 was a 2m/220 mobile, digitally-frequency-synthesized single box, designed by Jack Dickenson N6PI and Len Surrette of the Santa Barbara area.

I built them, and years later when I got my ticket, I made my first contact on one. The CST-50 was a miracle of miniaturization for its day; the frequency synthesizer was all 7400-series TTL.

I hope you'll set this straight. With all the America-bashing, we should at least give credit where it's due.

Jeff Berkowitz N6QOM
Beaverton OR

Thanks, Jess. Of course I remember Comcraft. I still have a 2 meter Comcraft which gave me many years of faithful service.

... Wayne

Little Rock Teams Up with Big Apple

The Crew at The Radio Club of Junior High 22 in New York City, a nonprofit organization using ham radio in education, has more than 200 teenagers on 15 and 40 meters every school day for at least eight hours. There are bound to be some interesting contacts.

Thanks to Bill McClintock K5SGG, Governor Bill Clinton of Arkansas, is now on the long list of supporters who believe in ham radio as a teaching tool. Bill the ham began working with the Crew in the fall of 1988. He introduced the students to Arkansas via countless QSOs on 21.395, their morning and evening frequency. As the term progressed, more and more Arkansas hams joined in, each bringing a view of life in a state many kids never heard of before.

Near mid-term, with increasing check-ins from newly admitted Arkansas operators, Bill the ham decided to go to the top. Bill the governor should know just what a tremendous educational service his fellow resident hams were providing to the children living on the lower east side of Manhattan.

Bill the governor was impressed. He delivered a letter of support and a full-size state flag, which had flown over the capitol of Little Rock, to the Radio Club of JHS 22. It is permanently on display in the classroom housing the main station and home of "Education Thru Communication."

Arkansas hams involved in education have been in contact with Joe Fairclough WB2JKJ, the executive director of Radio Club 22. Since the program works so well in New York City, and at other sites around the country, perhaps the children of Arkansas will be the next to reap the benefits of "Education Thru Communication." All this from a simple QSO on 21.395 MHz.

Joseph J. Fairclough WB2JKJ
New York NY

Number 31 on your Feedback card

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

At last! See box for the ***list of current Hambassadors****, in alphabetical order by country. Where only a country is listed, we have a vacancy; countries not listed at all have never had a Hambassador, and we will welcome volunteers. (Preference will be given to nationals of a country; please give years and experience as a ham.)*

Esperantist hams note: *Major S. N. Rai Deb Barma (Retired), Krishnaloy, Vivekananda Sarani, Narendrapur-743 508, West Bengal, India, expresses interest in the International League of Amateur Radio Esperantists (see June, 1988, issue, p.90, col. 4, and the July issue, p.91, col. 1).*

Roundup

Country of the Month: France. What tallest structure in the world (then) celebrates its centennial this year and was saved from being torn down by The Unknown Ham?

Well, sort of: When radio was invented, what was virtually the world's longest-range antenna was placed atop the structure. Then in 1914, thanks to the antenna, a secret message was picked up telling of an impending attack on the city in which this structure was built, and troops were moved into position in time for a famous battle. That ended all thought of demolition.

The structure was the Eiffel Tower, of course, the city was Paris, and the battle was of the Marne. The tower was built for a world exhibition and was not intended to be permanent—which was fine by its critics, one of whom called it a "hollow candlestick," and another, an "arrogant piece of ironwork."

It is a tourist landmark, and in honor of its birthday on May 15, tourists and the world will be seeing the first of many 1989 spectacles. One hundred giant lights will be turned on around the city and 100 giant balloons, 20' in diameter, will be launched to form a 15-mile ring around the tower. Fireworks will blaze into the sky, and the official birthday message is an exhortation "to make universal communication the great adventure of the 21st century."

The tower will be an "electronic Tower of Babel" for the rest of 1989, with a "World Channel" broadcasting radio and TV to every nation, in many languages, by satellite 24 hours a day. (From a story by John Njor, in *Politiken*, Copenhagen, reprinted in *World Press Review.*)

[In 1944, the RP part of CCC, then in the US Army Signal Corps which was using the tower, went to its topmost level, planning to climb the vertical ladder and then stick a hand higher than the tip. When he got up there he had no trouble changing his mind! Rereading a wartime letter home many years later, however, he found he had jokingly predicted he'd probably claim he did it, anyway. Embarrassing, because af-

CALENDAR FOR JUNE

1—Children's Day, China; National Day, Tunisia (7th for Chad, 25th for Mozambique).
2—Anniversary of the Republic, Italy; Coronation Day, Great Britain.
3—Labor Day, Bahamas.
5—Constitution Day, Denmark; Liberation Day, Seychelles; Bank Holiday, Ireland; Queen's Birthday, New Zealand (10th for Great Britain).
6—Memorial Day, South Korea; National Holiday, Sweden (10th for Portugal, 23rd for Luxembourg).
7—Independence Day, Norway (12th for Philippines, 26th for Madagascar and Somalia, 29th for Seychelles). *We asked this question a couple of years ago—and nobody took the bait. We're trying again: Liberation Day for the Seychelles was on the third. Independence Day on the 29th. What could the status of these 86 islands and its (now 67,000) people have been between June 5 (liberation) and June 29 (independence)?—CCC*
13—Corrective Movement Day, Yemen.
14—Flag Day, USA (20th for Argentina).
17—Republic Day, Iceland; Commemoration Day, West Germany.
18—Evacuation Day, Egypt; Father's Day, USA.
19—Revolution Day, Algeria.
22—National Sovereignty Day, Haiti.
24—Peasants Day, Peru; Kings Day, Spain; St. Jean Baptiste Day, Canada.

73 INTERNATIONAL HAMBASSADORS

Argentina
Australia—Ken Gott VK3AJU, 38A Lansdowne Rd., St. Kilda, Victoria 3183
Austria
Bahrain—Ian Cable A92BW, POB 22381, Muharraq
Bangladesh **Belgium**
Brazil—Gerson Rissin PY1APS, POB 12178, Copacabana, 20000 Rio de Janeiro, RJ; Carlos Vianna Carneiro PY1CC, Afonso Pena, 49/701, 20270 Rio de Janeiro
British West Indies (See United Kingdom)
Canada **Chile**
Canary Islands (See Spain)
China (People's Republic of)—Chang Han Dong (BY4AOM), Inst. of Estuarine & Coastal Research, East China Normal Univ., Shanghai 200062
Colombia **Costa Rica** **Cuba**
Cyprus—Aris Kaponides 5B4JE, POB 1723, Limassol
Czechoslovakia—Rudolf (Rudy) Karaba OK3CMZ, Gogol'ova 1882, 955 01 Topol'cany
Denmark **Dominican Republic** **Ecuador** **El Salvador** **Finland** **France**
Germany (Federal Republic of)[West]—Ralf Beyer DJ3NW, Opferkamp 14, 3300 Braunschweig
Great Britain (See United Kingdom)
Greece—Manos Darkadakis SV1IW, POB 23051, 11210 Athens
Hong Kong, Crown Colony of (See United Kingdom)
India **Indonesia** **Iraq** **Ireland**
Israel—Ron Gang 4X1MK, Kibbutz Urim, D.N. Hanagev 85530
Italy—Mario Ambrosi I2MOP, via Stradella 13, 21029 Milano
Japan (The Japan Amateur Radio League, Inc., Shozo Hara JA1AN, President, sends its regular publication to 73 International.)
Jordan
Kenya—Rod Hallen 5Z4BH, Box 55, APO New York 09675
Korea (Republic of)[South]—Byong-joo Cho HL5AP, POB 4, Haeundae, Pusan
Liberia **Liechtenstein** **Malaysia** **Malta** **Mexico** **Mozambique** **Nepal**
Netherlands (Kingdom of)—Joseph A. Stierhout PAØVDZ, POB 265, 6950 AG Dieren
New Zealand—Des Chapman ZL2VR, 459 Kennedy Rd., Napier
Norfolk Island—Kirsti Jenkins-Smith VK9NL, POB 90, Norfolk Island, 2899 Australia
Norway **Panama** **Papua New Guinea** **Peru**
Philippines—Leo M. Almazon WA6LOS/DU, 10098 Knight Drive, San Diego CA 92126
Poland—Jerzy Szymczak, 78 - 200 Bialogard, Buczka 2/3
Portugal—Luiz Miguel de Sousa CT4UE, POB 32, S. Joao do Estoril, 2765
Russia (See United Soviet Socialist Republics)
San Marino (Represented by Italy at this time)
Saudi Arabia
South Africa (Republic of)—Peter Strauss ZS6ET, POB 35461, Northcliff, ZA-2115
Spain—(Represented at this time by the Canary Islands Hambassador): Woodson Gannaway N5KVB/EA, Apartado 11, 35450 Santa Maria de Guia, (Las Palmas de Gran Canaria), Islas Canarias, Spain
Sri Lanka
Sweden—Rune Wande SMØCOP, Frejavagen 10, S-155 00 Nykvarn
Switzerland
Taiwan (Republic of China)—Tim S.H. Chen BV2A/2B, POB 30-547, Taipei, Taiwan 107
Thailand—Tony Waltham HS1AMH,POB 2008, Bangkok
Togo **Trinidad and Tobago (Republic of)**
USSR—Gennady Kolmakov UA9MA, POB 341, Omsk - 99
Venezuela **Vanuatu (Republic of)** **Yugoslavia** **Zambia**
Zimbabwe—Bernard C. Herring Z21EI, POB 2234, Bulawayo
United Kingdom
British West Indies—Errol Martin VP2MO, Box 113 Plymouth, Monserrat BWI, Leeward Islands Zone 8
Great Britain—Jeff Maynard G4EJA, 32 Waldorf Heights, Hawley Hill, Camberley GU17 9JQ, England
Hong Kong—Phil Weaver VS6CT, POB 12727

ter the war he really did "remember" he did it and probably had said so many times. Today he claims he has told only that one lie in his whole life. Oh? Right there is at least his third one....—CCC]

Malta. C.A. Fenech 9H1AQ (35, Main St., Attard, Malta) sends us the requirements for being a ham in the Republic of Malta. Apply to The Chief Inspector of Wireless Telegraphy, Wireless Telegraphy Branch, Auberge de Castille, Valletta, Malta. Fee (do not send until requested): 3 Maltese pounds (approx US$8). If you use the 73 International form (see last month's issue) provide this additional information: (1) Proof of Morse speed dated no more than one year before your application. (Required: 36 words averaging five letters long per three minutes sending, the same for receiving, with no more than four uncorrected errors; and 10 five-figure groups in 1-1/2 minutes, sending or receiving, no more than two uncorrected errors permitted. (2) Details of your occupation. (3) Home telephone number. (4) Mother's and father's names. (5) Circuit diagram of transmitter(s).

South America. The Brazilian magazine, *Electronica Popular* (Caixa Postal 1131, 20000 Rio de Janeiro, RJ, Brazil), sends us the following about its awards.

The EP-AA (sponsored by the magazine's Amateur Radio department, "CQ-Radioamadores"). Contact after March 31, 1967 with 60 countries bordering the Atlantic Ocean including one Brazilian oceanic island (PYØ). DXCC list countries only, and only Atlantic border countries—not of interior seas like the Mediterranean. All authorized amateur bands and transmission types with minimum report of 3-3 for phone and 3-3-8 for CW. Send log authenticated by a recognized amateur radio association and five IRCs (only IRCs, please!) to EP-AA Manager at above address.

Worked All PY Award (WAPY), sponsored by the magazine's Antenna Editorial Group. One confirmed two-way contact on or after May 15, 1981 (EP's 25th anniversary), any band, any mode with each of the nine continental PY call areas (PY1 to PY9; NOT valid are PP, PR, PS, PT, etc.). The award is issued to the amateur, not the callsign, but contacts must be made from the same call area if any, or same state or county. Send GCR list (no QSL cards) showing full details of QSLs, certified by a recognized amateur radio society. No fee for non-Brazilians, but it is suggested that 5 IRCs would be helpful to help cover costs. Send to the Antenna Editorial Group at above address.

Sweden. DXers who don't know about Radio Sweden (are there any?) should send for information (address S-10510 Stockholm, Sweden). Radio Sweden publishes a weekly *Sweden Calling DXers* bulletin, and "Listeners who send in media news go on the mailing list for one year." Send tips to George Wood at Swedish telex 11738, Telefax +46-8-667-6283, to CompuServe (Easyplex 70247,3516), through the FidoNet system (to 2:501/297, or to SMØIIN on the packet radio BBS SKØTM. A recent issue carried two-to-eight-line news items on broadcasts from 17 nations; the next (#2018 if you want it) listed publications available such as their own *Beginners Guide to DXing, Communications in Space–The DXers Guide to the Galaxy, The DXers Guide to Computing*, the first two free, the third for US$3 (GBP2, FF20, SEK20, DM7, or 7 IRCs).

Other titles listed, some evaluated, included *Passport to World Band Radio, World Radio TV Handbook, International Listening Guide, Ninety-Nine Nights on Medium Wave, Guide to Utility Stations, The Soviet Maritime Radioteletype Dictionary*, and other publications.

UK (Scotland). John McGill GM3MTH (Paddy) writes of awards by the Scottish Tourist Board (Radio Amateur) Expedition Group (PO Box 59, Hamilton, Scotland ML36QB). The Thistle Award is for contacting four separate STB events and the Supreme Tartan Banner Award for contacting a further two stations for a total of six. The first must be claimed first, separately, by sending QSLs or log extracts and US$2, 1 pound, or equivalent. For the second, send proof and US$3, 1 pound 50 or equivalent. Annotations awarded free for a further 2/4/6 etc. events. Available to SWLs on a heard basis. Address Awards Manager Robbie GM4UQG at above address.

NORFOLK ISLAND POPULATION ZOOMS TO ADDITIONAL PERSON PER TWO SQUARE MILES

[*Only temporarily, thank goodness! By now it should be back to its comfortable ±135 for each of its 13.5 square miles! We enjoy the placid-pace-of-life feeling we get while reading Kirsti's reports.* "*...the sea and the sky were both blue, and the Island was invitingly green....*" *Ahh! So sit back, heave a deep sigh, relax, and read the following at the rate of 100 wpm!—CCC*]

The end of 1988 saw quite an influx of visiting amateurs to Norfolk Island, combining a little operating with pleasure.

Mine JH1LKH arrived in October after a stopover on Lord Howe Island (VK9L), halfway between Sydney, Australia, and Norfolk Island, and the only land to be sighted over that stretch of water.

Mine operated as VK9NQ from Norfolk Island for a week, but did not devote all his time to the bands. He managed to make about 1,000 QSLs, mostly on CW. But the sea and the sky were both blue, and the Island was invitingly green after the winter rains and there was sight-seeing to be done.

Following on Mine's heels came Pete W6ZH, equipped with his truly portable home-brewed CW 20m rig. Pete and his wife, Meredith, spent most of their time exploring the Island, but in the late evenings Pete would come up on 20m CW as VK6BCW/VK9N. (Quite a mouthful! The VK6 call was due to Perth, in Western Australia, being his first landfall in Australia.)

No sooner had Pete and Meredith departed for New Zealand than Kari VR6KY arrived. She had been in New Zealand with her daughter, and as there was still time to wait for the next ship to Pitcairn, they came here to visit friends and relatives. Kari had most certainly not come to operate DX! That would be a busman's holiday. And after a few weeks of visiting, swimming, sightseeing and so on, they left in time to be home for Christmas.

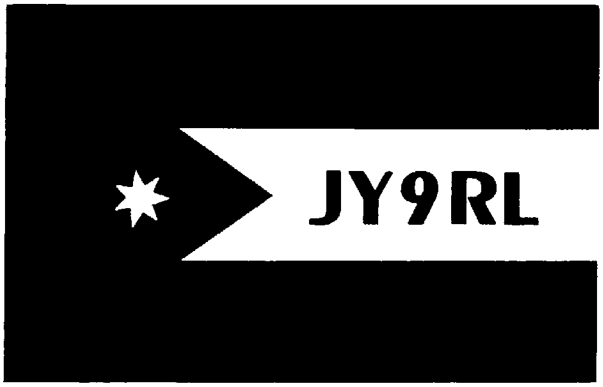
During this busy period of visitors, JOTA took place on the amateur bands, and the Scouts and Guides, who have been active here for decades, participated. Bob VK9ND acted as host to some 20 girls and boys, under the supervision of their scoutmaster. They talked with other young people in Australia and on some of the Pacific Islands. (Propagation and time limitations prevented chats with the USA and Europe.)

Direct shipping service to Australia has been withdrawn, and mail goes aboard infrequently-arriving ships which then travel via Fiji and goodness knows where else. The Post Office accepts no responsibility for the resulting delays.

Remember that one IRC pays for such surface mail ONLY! QSL cards are not accepted as valid for the "greeting card" rate. And postal rates are up. Air mail to the USA is now $1.00 and to Europe and South America, $1.10.

Be patient!

de Kirsti Jenkins-Smith VK9NL



Alan Kaul W6RCL submitted this for QSL card of the month—it came in second place—and is awarded the honor of being printed here! (Only overseas cards eligible.)

"What famous structure . . . was saved from being torn down by The Unknown Ham?"

Dx

Number 32 on your Feedback card

Hams Around the World

Chod Harris VP2ML
PO Box 4881
Santa Rosa, CA 95402

Antoine Baldeck F6FNU Controversial QSL Manager

The February, 1989, issue of *Radio*, the official publication of the Reseau des Emetteurs Francais (REF, the French equivalent of the ARRL), contains a notice that QSL cards coming from QSL manager F6FNU will not be accepted for any REF award after March 1, 1989. The International DX Association has severed all ties with F6FNU and asked him to stop putting the INDEXA logo on his QSL cards. And the ARRL has sent a letter to F6FNU concerning his controversial QSL practices.

These steps are particularly significant because Antoine Baldeck F6FNU handles QSLs for about 150 stations, including some very active DX stations and some stations in otherwise rare countries. Among the stations for which F6FNU handles cards are: FR/G/FH4EC, FTØWA, TR8SA, 6W6JX, 5R8JD, 5T5NU, FR4FA, 3B9FR, and many more, mostly French overseas operators. Antoine is a 56-year-old grandfather, of Eastern European descent. He is a retired engineer from the French power company and enjoys an 85% pension.

Investigation Begins

What has led to the above unprecedented actions? To find out, I launched a comprehensive, six-month investigation into Antoine Baldeck F6FNU and his QSL management. I received hundreds of pages of material on F6FNU, from hundreds of DXers around the world, much of it from Pierre Essinger F6HIZ (director of INDEXA), and from F6FNU himself.

The controversy surrounding F6FNU's QSL management began early in 1986, when Antoine sent a letter to the French DX newsletter *Les Nouvelles DX* (*LNDX*) stating that French hams who wanted a direct QSL card from Antoine are requested to add one International Reply Coupon (IRC) or an additional stamp to their self-addressed, stamped envelope (SASE), or F6FNU would answer via the bureau. (This would be equivalent to a stateside manager such as W3HNK refusing to answer directly a QSL request with a self-addressed envelope with a $0.25 stamp!) In other words, F6FNU asked for money over and above the cost of return postage for a direct QSL.

French amateurs were incensed by this requirement for a "tip" in addition to postage, an unprecedented practice. F6AJA, editor of *LNDX*, published an editorial against the demand for funds in addition to adequate return postage. F6EYS, president of the Clipperton DX Club, wrote Antoine:

"I believe that a manager who cannot break even (including mailing, printing, etc.) is badly organized. If one wants to make a profit, the explanation is different. He believes he is engaged in a trade, he becomes a commercial manager."

Antoine was quick to defend his practice of requiring additional funds from French DXers. He cited the expense of printing the cards, forwarding cards to distant stations, and helping with customs duties, spare parts, etc., all legitimate expenses for a QSL manager.

However, three separate letters from F6FNU cite another reason for the demand for additional funds. In a letter to F6AJA, one of the reasons given is "the hours spent." In a letter included with some QSLs, he says, "The extensive mail, the time I am spending to help them . . . is not for free. . . QSLing takes 5 hours per day." And in a letter to me, Antoine says, "I spent a lot of time and money on various stations." These statements from F6FNU could lead the DXer to think that Antoine expects payment for the time spent on QSL chores.

Beyond France

For some time, F6FNU's insistence on funds in addition to postage affected only French DXers. But the problem soon began to impact DXers around the world. For example, one US DXer sent two IRCs with each of two QSL requests to F6FNU. Although two IRCs are sufficient for airmail return to the US, Antoine returned the cards via "Imprime Air Mail," at a cost of 3.2 French francs (about $0.50), a tidy profit. Another stateside DXer sent three separate self-addressed envelopes with adequate French postage for airmail return. A card came back via the bureau. Antoine apparently kept the postage. Another US DXer sent four US$1 and two IRCs for five QSLs. He received one back via the bureau, another via Imprime mail, for a postage cost to F6FNU of $0.50. A very prominent DXer sent F6FNU three SAEs with three IRCs each and received his card back without postage via a package sent bulk to me! A local DXer has spent $20 trying unsuccessfully to get a card from Antoine. The cards arrived only after F6FNU was chastised for his QSL practices.

An SWL sent Antoine 10 cards with 6.3 FFrs and an IRC. Antoine cut the stamps off the envelope and returned the cards printed matter rate for only 3 FFrs, a profit of more than 6 FFrs. Even French stations who provide as much as 20 FFrs in addition to postage have had their cards returned unanswered, sometimes covered with insults.

Lately, Antoine stopped sending cards even when the US amateur included a "greenstamp" (US $1 bill). Antoine says this is because US$1 is not enough to pay for the airmail postage back to the US, but a single card in an airmail envelope can be sent from France to the US for 4.8 FFrs, and US$1 equals 6.2 FFrs. Even with a 10% conversion tax, the US$1 more than covers the postage.

Antoine refuses to answer QSL requests from foreign DXers who do not include funds in addition to airmail return postage. He says, "People who send French stamps, Hi Hi. Never I send to W3HNK, or W4FRU, WA3HUP an SAE with $0.45. This process don't agree me. It's good only for very poor, poor peoples."

QSL via the Bureau?

Many DXers prefer to QSL via the worldwide bureau system. Antoine states in letters to F6AJA, "Those who have the real ham spirit should send all their QSLs only through the bureau, as it is my wish," and, "I prefer to receive the French QSLs via the bureau as I can take all the time to control them and to answer them twice a year via the REF." But later Antoine writes, "I have resigned from the REF. Consequently, no more QSL via the bureau." Antoine says that 98% of his French friends are not members of the REF and thus cannot receive cards via the REF bureau. (About 50% of French amateurs are members of the REF.)

Many DXers outside of France have received cards from F6FNU via their own bureau. Antoine sends cards that he receives without SAEs (or without adequate payment in addition to postage) to various bureaus worldwide, including the W2 bureau. These cards are eventually distributed via the in-coming bureau system.

How to Get a Card from F6FNU

Despite all the problems, F6FNU does QSL, if you follow his rules to the letter. Thousands of DXers around the world have learned to live with Antoine's rigid rules and receive their QSLs on a timely basis.

In fact, more than a dozen DXers wrote letters to me specifically defending F6FNU, saying he is a good QSL manager.

Many stated that by sending US$2 and an SAE, or sufficient funds in addition to return postage, they never had any problem getting cards from Antoine. Antoine even sent copies of more than 100 thank you notes he has received over the years. Obviously, the majority of amateurs are willing to accept his rules, in exchange for their QSL.

To get a card from F6FNU, first select a good-quality, unaltered QSL card, with your callsign on the same side as the report. Then carefully fill out the card, paying particular attention not to smudge or correct any of the information on the card, regardless of importance. Any errors will probably mean you will not get a return QSL, so if you make a mistake, don't correct it; start over with a new card.

Then send the card to Antoine Baldeck F6FNU, B.P. 14, 91291 Arpajon Cedex, France, with a self-addressed, airmail envelope, with your country clearly indicated on the return envelope. Don't try to use return address stickers to reduce return postage costs; Antoine doesn't like them. Don't send cards for more than one callsign in a single envelope. Include one IRC per request for Europeans, two IRCs for anyone else. Don't send French stamps or foreign currency. (Antoine says not to send US$1, but he does QSL if you send US $2, or US $1 with an SASE.)

If you follow these rules, you have a 90% chance of receiving your return QSL. Good luck! 73

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the June issue, we should receive it by March 31. Provide a clear, concise summary of the essential details about your Special Event.

PEOTONE IL
MAY 21

The annual Hamfest sponsored by the Kankakee Area Radio Society will be at the Will County Fairgrounds from 8 AM to 3 PM. Indoor exhibit area, ARRL booth, large outdoor flea market. Free parking. $2.50 advance, $3 at door. Talk-in on 146.34/.94. *KARS c/o Frank DalCanton KA9PWW, RR 1 Box 361, Chebanse IL 60922. (815) 937-2452 before 4 PM CST or (815) 932-6703 evenings.*

SCOTTSBLUFF NE
JUNE 2–4

The Tri-City Radio Amateur Club will operate WØVQN to celebrate the Centennial of Banner County. Suggested frequencies: SSB—3.920, 7.240, 14.250, 21.300, 28.400, 52.50. CW—3.725, 7.125, 14.125, 21.120, 28.130. For QSL and large certificate, send SASE to *PO Box 925, Scottsbluff NE 69363-0925.*

CATSKILLS NY
JUNE 2–5

The 3rd international convention of Chaverim International for Jewish amateur radio operators will be at the Raleigh in the Catskill mountains. Three meals a day, entertainment, use of facilities, cocktail party, dinner dance, meetings. *Sonny Gutin WB2DXB, 42 Arrowwood Court, Deptford NJ 08096. (609) 853-7889.*

JOHNSTOWN PA
JUNE 3

The Conemaugh Valley ARC will operate WA3WGN to commemorate the centennial of the flood of 1889. Operation will be on the lower General phone bands of 20 and 40 meters, and the Novice phone portion of the 10 meter band. For commemorative QSL, send #10 SASE to *Conemaugh Valley ARC, 194 Barron Ave., Johnstown PA 15906.*

DEERFIELD NH
JUNE 3

The Hosstraders flea market is back at the Deerfield Fairgrounds. New date, this spring only. Admission, $5, camping nominal. Profits benefit Shriners' Hospitals, last year's gift over $20K. Handicap accessible. Questions, map, send SASE to *WA1IVB, RFD Box 57, West Baldwin ME 04091.*

ATHENS GA
JUNE 3

The Athens Radio Club will hold its annual Hamfest at Athens Tech. VE exams, walk-ins welcome (bring copy of license). No charge for admission or flea market space. Talk-in on 146.745/.145. *Don Bullard WA4IML, (404) 742-7261 after 6 PM EST.*

MARTINSVILLE IL
JUNE 3

The Eastern Illinois Hamateur Radio Club will hold its first annual Hamfest/Craft Show at the Martinsville Fair Grounds. Admission, $3; 12 and under, free. Talk-in on 147.03/.63 and 146.52 simplex. *Mike Bumpus N9GIK, RR2, West Union IL 62477. (217) 279-3840; or Bryan Chrysler, 110 N. Randall, Martinsville IL 62442. (217) 382-4640.*

WENATCHEE WA
JUNE 3–4

Apple City ARC W7TD will hold its Hamfest at Rocky Reach Dam. $5 for hams, $1 for others. Free camp/trailer space with power. Prize drawing after Saturday potluck. Equipment displays, Swap Shop, VE exams, fish viewing room, banquet, arts and crafts. Talk-in on 2 meter FM, 146.30/.90, 147.38/.98, 146.49 simplex. *Bob Lathrop, Treasurer, 919 N. Woodward Drive, Wenatchee WA 98801.*

MADISON OH
JUNE 3–4

The Wireless Institute of Northern Ohio (W.I.N.O.), sponsored by the Lake County ARA, will operate KO8O from a winery to commemorate Ohio Wine Month from 7–11 PM EDST the 3rd on 7235 and 14235 kHz, and from 11 AM to 3 PM EDST the 4th on 14235 and 21310 kHz. For 8 1.5x11 QSL, send legal-sized SASE to *KO8O–WINO Weekend, 10418 Briar Hill, Kirtland OH 44094.*

QUEENS NY
JUNE 4

The Hall of Science ARC Hamfest will be at the New York Hall of Science parking lot, Flushing Meadow Park, in Queens. Amateur radio exhibit station, tune-up clinic, films, free parking, door prizes, commercial dealers. $3 admission. Sellers, $5 per space. Talk-in on 144.300 simplex link 223.600 repeat and 445.225 repeat. Call at night *Steve Greenbaum WB2KDG, (718) 898-5599 or Arnie Schiffman WB2YXB, (718) 343-0172.*

CHELSEA MI
JUNE 4

The Chelsea ARC, Inc., is sponsoring its Swap 'N Shop at the Fair Grounds. Admission, $2.50 in advance, $3 at door. YLs, XYLs, and kids under 12, free. Table space, $8, trunk sale, $2 per space. Campgrounds in area, plenty of parking, special handicap parking. Talk-in on 146.980 Chelsea Repeater. *Robert Schantz, 416 Wilkinson St., Chelsea MI 48118. (313) 475-1795.*

ST. LO, FRANCE
JUNE 6

ATTENTION D-DAY HAMS: The A.R.AM ham club in St. Lo France is seeking US hams who participated in the invasion of France on D-Day, or shortly afterwards, landing on Utah Beach. Join the A.R.AM Club on the air in a 45th anniversary commemoration. Reply with an SASE, include unit ID and date of landing to *W2QFC, 308 Parkdale Avenue, East Aurora NY 14052-1619.*

DADE CITY FL
JUNE 9–11

The East Pasco Amateur Society will operate special events station AB4LN to celebrate the Centennial of Dade City. Operations begin daily at 10 AM. Phone band operations will be 10 MHz up inside the General/10 meter Novice phone band. RTTY operations will be in accordance with the band plan. Send your confirmation QSL and business-size or 9x11 SASE for certificate. *EPARS Centennial, AB4LN, PO Box 942, Dade City FL 34297-0942.*

MIDLAND MI
JUNE 10

15th annual Hamfest, sponsored by the Central Michigan Amateur Repeater Association, will be at the Midland Community Center. Amateur electronics and equipment (new/used), license exams, door prizes. Admission, $3. Tables, $8. Talk-in on 147.000 + 0.600 MHz. *CMARA Hamfest, PO Box 67, Midland MI 48640. Please SASE or call (517) 631-9228 evenings and weekends.*

MILFORD CT
JUNE 10–11

Milford will celebrate its 350th anniversary with a special events station from 1200Z Saturday to 2200Z Sunday. Frequency will be in the lower third of the General band 80 through 15. 10 meter operation will be in mid portion of Novice phone band. 2 meter, via 146.925 repeater. Special QSL available with QSL and SASE to *PO Box 1639, Milford CT 06460.*

NEW PHILADELPHIA OH
JUNE 10–11

The Tusco ARC will operate W8ZX beginning 1700 UTC on the 10th to celebrate the 50th anniversary of the club. To promote interest in amateur radio, they will give demonstrations of packet on 145.050, and 2 meter repeater operations on 146.730. Other frequencies: 28.400, 21.340, 14.300, 7.265, 3.945. For QSL, send SASE to *W8ZX, PO Box 725, New Philadelphia OH 44663.*

AKRON OH
JUNE 11

The Goodyear Amateur Radio Club's 22nd annual Hamfest and Family Picnic will be at Wingfoot Lake Park near Akron. Family admission, $4 in advance, $5 at gate. The outside flea market will be $3 per vehicle. A sheltered, inside dealer area available, at $6 per table (reservations suggested). Prizes for the OM, XYL, and Mobile Check-in. Park facilities. No overnight, no swimming. *William F. Dunn W8IFM, 4730 Nottingham Lane, Stow OH 44224. (216) 673-8502.*

WILLOW SPRINGS IL
JUNE 11

The 32nd annual Hamfest, sponsored by the Six Meter Club of Chicago, Inc., will be at the Santa Fe Park in Willow Springs. Advance, $3, at gate, $4. Large Swapper's Row, displays in pavillion, AFMARS meeting, prizes, picnic grounds, plenty of parking. Talk-in K9ONA 146.52 or K9ONA/R 37–97. Advance tickets from *Mike Corbett K9ENZ, 606 South Fenton Ave., Romeoville IL 60441.*

MADISON IN
JUNE 11

The Clifty Amateur Radio Society will sponsor its 2nd annual Novice Graduation with a special events station operating 1500–2100 UTC on the 11th, using callsign W9EFU. 25 KC up from the bottom of the Novice bands. QSL with #10 SASE to *Clifty Amateur Radio Society, PO Box 452, Madison IN 47250.*

COVINGTON KY
JUNE 11

The Northern Kentucky Amateur Radio Club announces HAM-O-RAMA 89 to be held at the Erlanger Kentucky Lions Park. Main and door prizes. ARRL, packet, and antenna forums. Indoor exhibit area for major vendors, $15 per table. Extensive outside flea market. Admission, $5 ($4 in advance). Flea market spaces $2 each. Talk-in on 147.855/.255 or 147.975/.375. *N4OEB, NKARC, PO Box 1062, Covington KY 41012. (606) 331-3258.*

MILTON PA
JUNE 12

The Penn Central Hamfest will be held at the Winfield Fireman's Fairgrounds. Games, demonstrations, contests. $4 at gate, $1 per 6-foot tailgating area. Inside tables with electricity, $2 per 6-foot area. *Jerry Williamson WA3SXQ, 10 Old Farm Lane, Milton PA 17847. (717) 742-3027 or Bob Stahl, 452 4th St., Northumberland PA 17857. (717) 473-7050.*

BOULDER CO
JUNE 12–DEC 11

VE Team Test Schedule: June 12, August 14, September 24, October 16, November 13, and December 11. Pre-registration preferred. Tests at American Legion, 4760 28th St., in Boulder. Bring picture ID, one other ID, check or M.O. payable to ARRL-VEC for $4.75, original license and copy, any credits for any test elements, copy of any FCC 610 you submitted, soft pencils, calculator. *Barbara McClune NØBWS, (303) 530-1872.*

ALBANY GA
JUNE 16–17

The Albany Amateur Radio Club is sponsoring the 1989 ARRL Georgia State Convention. Awards, forums, exams, indoor flea market, commercial exhibits. Admission, $3. Parking, free. Talk-in on 146.82 MHz, 444.5 MHz, 29.68 MHz. *Albany Amateur Radio Club, POB 1205, Albany GA 31702. (912) 883-7910.*

ALBERTA CANADA
JUNE 16–18

The Central Alberta Radio League Annual Picnic will be at the Burbank Campsite. Door prizes, bunny hunt, barbecue, fun. Talk-in VE6QE 147.00/146.400 or 147.330 simplex. Register at the communications bus, $15. $5 more for private campsite. *P. Fitzgerald VE6QT, (403) 746-2621 or D. Miller VE6XF, (403) 886-4883.*

DUNELLEN NJ
JUNE 17

The Raritan Valley Radio Club will hold its 18th annual Hamfest at Columbia Park. Sellers, $6 per space or $12 for multiple spaces. No tables supplied. Buyers, $4 admission, spouse and family free. Door prizes. Talk-in on the club repeater, W2QW/R 146.025/.625 and 146.52 simplex. *Dave KA2TSM, (201) 763-4849 or John WA2C at (201) 968-5070.*

BYRON CENTER MI
JUNE 17

The Independent Repeater Association is sponsoring its annual Hamfest at the National Guard Armory. Free tables for dealers and sellers. Reserve tables. Door prizes. Talk-in on 147.165/147.765. *The Independent Repeater Association, 562 92nd St. SE, Byron Center MI 49315. (616) 455-3915.*

PETOSKY MI
JUNE 17

The Straits Area Amateur Radio Club presents its 14th annual Swap Shop at the 4H Building on the Fairgrounds. Admission, $2.50; tables, $3 per 8 feet. Door prize, small prizes each quarter-hour. Self-contained RV parking. Talk-in on 146.08/.68/.52. *Irene N8HBT, (616) 539-8986 or Clark KA8TIL, (616) 582-6455.*

MONROE MI
JUNE 18

The 1989 Monroe Hamfest, sponsored by the Monroe County Radio Communications Association, offers vendor exhibits, flea market, FCC exams, more. Handicapped parking inside the grounds. $3, advance, $4 at gate. Talk-in on 146.12/.72 and 223.18/224.78. *Larry Lindner KB8AIZ, 2001 Ida-Maybee Rd., Monroe MI 48161. (313) 587-3663.*

STEVENS POINT WI
JUNE 18

The Central Wisconsin Radio Amateurs are sponsoring their Hamfest at UWSP's Student Center. Free admission, parking. Tables available. Tailgaters welcome. VE exams, walk-ins OK. Commercial vendors and exhibits. Talk-in on 146.985/.385/.670/.070. *Art Wysocki N9BCA, 3356 April Lane, Stevens Point WI 54481. (715) 344-2984.*

MIDDLETOWN MD
JUNE 18

The Frederick Amateur Radio Club will hold its annual Hamfest on Father's Day at the Frederick County Fairgrounds. Admission, $4; tailgaters, $5 per 10-foot space. Spouses and children free. Indoor tables, $10. *Dave Durkovic N3BKD, 7128 Limestone Lane, Middletown MD 21769.*

SANTA MARIA CA
JUNE 18

The annual Santa Maria Radio Swapfest will be at the Union Oil Co. Newlove Picnic Grounds. Swap tables, prize drawings, games, Santa Maria Bar-B-Q. All proceeds support the programs of the Satellite Amateur Radio Club. Talk-in on 146.94 (down) WB6IIY/R. *Hank Korczak W6PME, 917 West Anthony Way, Lompoc CA 93436. (805) 736-1761.*

NYC NY
JUNE 26

The Radio Club of Junior High School 22 NYC, Inc., will operate WB2JKJ from 1100–2000 UTC on the above date in recognition of the first day of summer vacation for the school children of the Big Apple. 7.238 and 21.395 MHz only will be used. For an incredible QSL, send your card to *The Crew at 22, PO Box 1052, New York NY 10002.*

continued from p. 6
have learned to read—and providing you bother to take the time to read—you know that the average American parent spends less than 15 minutes a week talking with their kids. They spend much more than that yelling at them. Is it any wonder our kids don't have the incentive to do much in school? That they are messing with drugs, getting pregnant, wasting their time cruising or loafing around the mall, smoking, and have little focus in life?

So, in annoyance, we push our schools to pass 'em anyway. And we watch the SAT scores plummeting. We watch America being passed by Japan, Taiwan, Singapore, and Korea. We read with dismay that our kids can't read and don't even know where our country is on a world globe. We read that only 7% of our high school graduates can even hope to cope with an engineering college. We read about less than 10% having any physics in high school. We read about our graduating technological illiterates—into a world which is technology-driven.

As Pogo once said, "We have met the enemy and he is us." Just as we neglect our pets and put up with their bad habits, we have also neglected our children. Then, when they "go bad" we throw them out. Throw out the pregnant teenage daughter. Throw out the drug-using kid. "Get the hell out of here and don't come back." Blame them, not us.

The loved child isn't going to shoot his parents or run away from home.

What's more important to you: a temporary fix from the Today Show; quickly forgotten entertainment-driven news; totally wasted time with Geraldo, Oprah, or Donahue; an evening of brainless sitcoms; or working with your kids to help them cope with life? Can you turn off the TV and miss football?

No, I see the problems which face amateur radio as just a reflection of those facing our country. Have you brought forth a whiny, complaining youngster who wants everything made easy? Or do your kids move heaven and earth to learn and excel—like the Asian youngsters? How hard will they work to achieve things?

Our educational system is a shambles because we've let it get that way. We've refused to be involved. Anything which is neglected is going to deteriorate, right? As parents we've neglected our kids, and our educational system. As hams we've neglected our hobby. Perhaps it's approaching time to rethink our priorities.

I wish I had some easy solutions to getting kids interested in amateur radio. For two years now I've been asking the *73* readers to look around for some way to get kids into the hobby. For two years I've had almost no letters from readers explaining how they've attracted kids to hamming. I've had plenty of mail from disgusted hams blaming the kids for not being interested.

I've had plenty of letters with excuses. Kids are interested in computers now. They see the world on TV, so they haven't any interest in talking with foreign hams. They're too busy with other interests. There are too many things for kids to do.

Baloney! When I got into hamming I wasn't exactly short of other interests. I was a Boy Scout, complete with troop and patrol meetings, hikes, weekend camping trips, and so on. I sang in the St. Paul's Church choir, which kept me busy three times a week practicing and two performing. I also sang in the Erasmus Hall High School Choral Club, where we practiced five days a week. I sang in the Savoyards two days a week, and with the Philharmonic Choir of Brooklyn two days a week. I was into photography and the school camera club—including an amazing number of hours in the YMCA darkroom. I didn't miss much in movies, going two or three times a week. I roller-skated all over Brooklyn in the evenings with friends, went ice skating and sledding in the winter, swimming at Coney Island in the summers. And yes, dancing lessons, too.

In between building electronic gadgets—a hi-fi system, receivers, transmitters and test equipment—I had fun experimenting with making explosives, ran a small mall order stamp business (Elm Stamp Company), took voice lessons, was a member of the book club in school (read a lot), and loved to play card and board games with my folks and their friends.

I've talked with some of the few young hams we have attracted to our hobby and found that they, like me—and probably like you, when you were a kid—have plenty of interests from which to choose. The difference for them, as for me, was the support of a local ham club. If my high school hadn't had a ham club I wouldn't be haranguing you now.

How can you get your own kids to be interested in amateur radio? Easy. But first you have to gain their confidence. You have to learn how to talk with them. That, as I mentioned earlier, is a lot like the system you use to train animals—you spend some time with them and use love. Do things with them. Talk with them.

If you get interested in this you'll have to be careful. After years of neglect you aren't going to be able to get them to talk right away. They'll be very suspicious at first. You'll have to figure out how to get them to turn off their TV or turn off the heavy metal sound so they can hear you. Good luck.

I'd still like to hear from any readers who have had success in getting a youngster interested in amateur radio. I know there have to be dozens who have made the grade, so let's hear from you! What can you tell us to help?

Once you manage to get in communication with your kids, you're going to be appalled by what's happened to our educational system and you're going to start putting on the pressure to improve it.

We all know that technology is the future and that electronics is the engine driving technology. We also know that the best time to get kids interested in becoming an engineer or scientist is when they are ten to fifteen years old. So we need to get those radio clubs going in schools again. We need computer clubs, science fair project clubs, etc. As you get more and more involved with your schools you'll find one obstacle after another—almost insurmountable obstacles. Don't let that stop you.

You'll face bussing, fierce union demands for extra teacher pay to monitor clubs, after-school sports. Well, if you want to see America ever get back first place in electronics, you'd better be able to solve all these problems. You'll have one big asset—me and *73* backing you up and helping you network with other parents (and grandparents). I can't do it all, but I sure can help you. That's providing I can get you away from your TV set long enough to talk with your kids. And away from that 75m net, too.

Yes, I'm asking the almost impossible. I'm asking you to try and love that mewling, whiny kid of yours who is forever in need of money to spend on beer which will eventually get him killed in an accident, fast food which will give him heart trouble in a few years, cigarettes which will take at least fifteen years off his life, who is listening to rock music at a level which will cause permanent ear and possibly brain damage . . . and who wouldn't be caught dead in your ham shack.

America is only about a million engineers short right now, so it isn't an emergency. Besides, I'm sure you've read that over half the engineering graduates from American colleges are foreigners, with a high percentage from Asia. If you've been reading the science columns in the news and science magazines you are well aware of the high percentage of Asian names turning up in every new technology.

Electronics is moving ahead faster and faster and, because of our lack of engineers, we're being left behind. You know, as a result of that Incentive Licensing debacle 25 years ago, America has lost about two million of the best possible engineers, technicians and scientists that amateur radio would have provided.

So, if you have youngsters or grandchildren, what are you going to do about taking an interest in them? In their education? And in getting them into amateur radio?

Please advise.

New Technologies

The FCC's Office of Engineering and Technology (OET) seems to have considerable clout within the FCC and could have a serious impact on amateur radio.

It's the FCC's responsibility to apportion the radio spectrum in the best interests of the country. With electronics and communications growing at a faster and faster pace, and the Hertz resource unchangeable, obviously something is going to have to give.

AM broadcasters want more channels. FM broadcasters want more channels. TV wants wider channels for high definition TV. Cellular radio is growing rapidly—as are mobile services for business, government and the military. Then, there are an increasing number of radio services such as portable phones, TV distribution systems, alarm systems, paging systems—the list is almost endless and expanding every day.

With over 70 MHz of spectrum under 1 GHz, the amateur radio "service" is one of the largest spectrum holders. Older hams are so used to having this enormous number of frequencies reserved for their personal, private hobby use that few even question the rationale involved. I've written several editorials mentioning the incredible dollar value of our ham bands, but I suspect many hams just chuckle a bit and never give any serious thought to the situation.

Let's put it this way. If you were a decision-maker in the OET, what would you recommend the FCC do? You've got an increasing number of groups clamoring for radio spectrum, yet it's all allocated. If any current services are going to expand or any new ones be permitted, frequencies are going to have to be taken from some current user. Where are you going to get them?

When you take an inventory of the radio spectrum under 1 GHz, looking at national interest in the light of service and business interests, what frequencies are being used the least in the public interest?

We amateurs have our reserved bands with the understanding, as expressed clearly in the amateur regulations 97.1, that we continue to merit them by maintaining a supply of newcomers interested in technology who (1) can help in time of war, (2) provide emergency communications, (3) invent and pioneer new communications technologies, and (4) improve international friendships. That's our mandate—our leasing agreement for the billions of dollars in radio spectrum set aside for us.

If you were an OET investigator, you'd check out our actual ham band usage and turn in a devastating report. In WWII, 80% of the licensed hams joined the military and provided an invaluable resource. WWII was won by electronic technology and hams were right in the middle of it—doing research and development, manufacturing, operating, and servicing.

I worked for General Electric in 1942, building and testing BC-191/375 transmitters for the Army. Then I joined the Navy, where I operated and maintained radio, sonar, and radar equipment on the USS Drum (one of the top ten scoring submarines) from 1943–1945—so I was there and know what a big difference hams made.

Today, what have we to offer? The number of hams of military age are miniscule—and, in general, hams are so far behind the state of the art in communications technology that we're still fighting over Morse Code at a few words per minute in a day where 8,000 word a minute electronic communications is common. Hams haven't contributed anything significant to communications technology in over a generation, so that excuse for the hobby is moot.

We're still getting good marks in emergency communications—but more from a lack of competitors than our own expertise. The fact is that when an emergency comes along our so-called emergency nets fall apart. Our National Traffic System only seems to work when it isn't needed. It's still made up of brasspounders, and still isn't able to pass high speed or automatic traffic. It's more wrapped up in message counts and protocols than throughput, as those involved saw during recent emergencies such as the Mexico City earthquake. Can packet radio already run circles around our traffic

nets, as so many involved are saying?

International good will? Har de har. I've written about that recently and gotten many letters from foreign hams backing my observations that DX awards kill the fun of hamming for ops in rare countries. They're hounded off the air for their QSL cards and are almost never allowed to actually talk with anyone.

When is the last time you tuned six meters? How many dozen hams would be inconvenienced if six were taken away for some new service? Not many! That's four whole megahertz! Well, at least two meters is full, right? Horsepucky! I've been listening to 2m all around the country and what I hear are repeaters being used to allow retired hams to die from boredom instead of loneliness. I hear very few repeaters where I can even get an answer when I call in, so I know hardly anyone is actually using them. And that's what's "filling" two meters. If you ever get to New York or Los Angeles, check out 2m and you'll hear garbage you don't even hear on CB anymore—incredible filth.

220? Tell me about how much you are using 220. The FCC's opened part of the band to Novice voice, but the Novices are ignoring the band and flocking to 10m, where they can make phone contacts with skip stations. The clubs with 220 repeaters are, for the most part, willing to go to great lengths to keep the imagined hordes of Novices from polluting their repeaters.

In the meanwhile, we seem to have forgotten that hams were given only temporary use of 220-225 MHz, not permanent ownership. So tempers flared when the FCC had the gall to suggest that some of the band might be put to some better use. Hey, that's OUR band they're trying to take away. Well, it was never OUR band and our use of it during its loan hasn't been anything of which we can be proud. I remember passing out buttons at hamfests twenty years ago which said, "220—use it or lose it." Well, for the most part, we never could be bothered to use it. How else could we have proven to the FCC that we needed 220-225 MHz? We're awfully big on griping and low on using.

Then there's 450 MHz—which has almost entirely been taken over for remote control and relay operations. Much of this could just as well be on 10.5 GHz. Most controlling could be done on channel on two meters these days. How much use of any value to our country do we contribute on 450? Yes, I know there are exceptions—but that's what they are: exceptions.

Is it all doom and gloom? Well, not if there's a solution to the problem. Right now we're in the weakest position we've ever been in with amateur radio—and that's because so many old timers are willing to take the hobby right on down with them to the grave. We need young Novices, need 'em by the hundreds of thousands. With new blood coming in we will be able to honestly say that we're a viable service and rate the government reserving our frequencies for us.

I'm still hearing old timers on the air, and getting letters from them saying all is hunky-dory, that there's nothing to worry about—ham radio is growing just fine—that we must keep on the pressure for the Morse Code. They're still doing all they can to keep youngsters out of their clubs, still doing nothing to help school clubs get started, and still will have nothing to do with Novices.

So, if you were an OET investigator, what would you recommend to the FCC? Be honest now.

Well, yes, but listen to how crowded 20m is these days—right? Sure, but it's awash in a 30-year old technology which should have been replaced years ago by much narrower band systems. Complaining about the QRM on 20m today is like beefing about the QRM back in the old spark days—and we're just two generations away from there, when we should be three or four.

We have the technology today to narrow our voice channels down to a few Hertz—using digital techniques and chips. We could get hundreds to thousands more voice channels on 20m, each with far less interference than we have right now. We could if we had some experimenters left. Alas, ham gear than we. Many Japanese ham manufacturers don't bother to try and sell to the small ham market we have left here.

With the OET on the move, the day of reckoning—the day many older hams have been blind to and refuse to even face—may be approaching. Is it already too late? I don't know. You tell me. Do you think there is any fight left in the mass of retired hams who are enjoying the hobby they've inherited from the pioneers who won it for them fifty years ago? Do you think they care about the future enough to get Novice programs going in their clubs and start reversing the trend of the last twenty-five years?

On every side we see the importance of electronics—the incredible developments in video, computers, and communications. We hams know perhaps better than most other people the way these developments will shape the future of the world as technically improved education systems bring

"CQ/Ham Radio *(Japan)* is fatter than all of our ham rags combined . . ."

most of them have died or retired, and our lack of youngsters coming into the hobby has cut off our major input from these chaps for the last twenty-five years.

Will the broadcast industry be able to get the rest of 220 MHz for a new FM band? They tried once to get it, failed, and are now trying again. Their prospects are brighter this time. Their proposed service makes sense as a place for a new digital FM service with 200 kHz channels.

The time when amateur radio could count on holding on to the ham bands without having any real justification may be passing. The question you should be asking today is this: How many Novices has my ham club generated this month?

You have noticed the full pages of Silent Keys in *QST*, haven't you? You may be sure the OET noticed. With the average ham age approaching 60, this list will be heading toward two pages a month as the smokers and overweight hams blow away. It takes ten years for the FCC list to catch up, so many old-timers will continue to believe the seriously inflated figures we've been seeing. QRM? Hey, the last two hams left on 20m will both be calling CO at the same time on the same frequency.

The Japanese are serious about amateur radio. Perhaps you've noticed that all of the technical innovations in our rigs for the last twenty years or so have come from Japan—like our incredibly small synthesized hand-held and our new computer-controllable synthesized rigs. They've been attracting youngsters in Japan—hundreds of thousands of them. It only takes one look at any of their ham magazines to see the difference. *CQ/Ham Radio* is fatter than all of our ham rags combined, running well over 600 pages a month. Every issue is packed with great construction projects, a whole section on club activities, contests. They have a much wider selection of down costs, as communications do more and get cheaper via satellites and fiber optics.

The compact disc application of digital data storage to audio has turned into the fastest growing consumer electronics industry in history. Now we're getting ready for digital video, high definition TV, and many other remarkable developments—all coming from Japan. Indeed, the Japanese may have lost the military war forty years ago, but they're winning the economic war—and winning much of it with electronics which they're using in cars, cameras, and to take away every consumer electronics industry from America with both home and office products.

Oddly enough, the American shortfall in electronics engineers, technicians, and scientists is just about what amateur radio would have contributed to our country if we'd not suddenly stopped ham growth twenty-five years ago. Blaming the ARRL or the FCC for this now is pointless. The need is to recognize the problem and solve it, to figure out how to generate the needed technical people to get America back in the technological race and thus to help regain American economic clout. Until then we'll have to get used to more and more Japanese-owned hotels and businesses here.

No, of course this isn't the only problem America has. We desperately need someone in Washington who has the responsibility to get America back to Number One. Someone to tackle the educational and tax problems which have contributed to our downfall. Someone to organize us to get back to being Number One.

In hopes of throwing some light on this need I tried throwing my *73 Magazine* baseball cap into the New Hampshire political ring, aiming at the Vice Presidency. My idea was to elect a vice president who would have actual work to do, just like in any corporation. The job of sitting around waiting for an accident wastes a valuable person. I'd like to see himbe in charge of the national economy, while the president is mainly involved with international problems. The VP would report to the president, just like a corporation.

This would give some clout at the top level for modernizing our educational system, developing ways to cut educational costs, making it easier for small businesses to start and grow, and to encourage American firms to outdo the Japanese in newer technologies.

The local press was much more interested in reporting again on my losing battle with the IRS 15 years ago than on my ideas for improving education, cutting college costs, and regaining American technical leadership. I picked too big an outfit to fight, believing that being right would win.

If I were to become VP you can bet I'd get simple courses on basic electronics into every grade school in the country—and I'd get 'em to start thousands of radio, computer, electronic experimenter, and science fair clubs to get kids personally interested in learning, building, and experimenting.

I'd make sure kids understood how computers, photocopiers, facsimile, telephone systems, cameras, radios, televisions, video recorders, tape recorders, etc., all work. They'd be familiar with CD, CDV, CDI, HDTV, and so on. They'd know how microprocessors work, how to program computers, and understand digital electronics—all by the age of 15.

I'd encourage schools (and colleges) to test and use more productive teaching systems. I'd encourage colleges to try work-study programs to cut tuition costs. I'd encourage all schools to go to 50-week a year teaching to make better use of schools and teachers.

How about encouraging video instruction systems such as CD-I to help more youngsters learn to read—to help high school dropouts learn—to re-educate workers who need to learn new skills?

These ideas aren't from left field. I've talked them over with many college presidents and have found them all most receptive. But the need is for pressure from the government to bring about needed changes.

Will America lose out on fiber optics—on superconductors—and many new electronics technologies? Japan is working hard to beat us. What are we doing? Japan knows they still have to fight to keep ahead, but the message hasn't penetrated here yet. So here we are with Japan the number one country in the world in technology and finance, while America has the highest foreign debt in the world and even has to turn to Japan with military electronic R & D contracts.

For starters I'd like to run a list of the American ham clubs and the number of new Novices they're graduating. Please have the secretary of your club send me a card or note every month telling me how many Novices your club graduated last month. Please send me pictures of your club Novice graduating classes for possible publication in *73*. I'll come up with an award for the top clubs in recognition of their interest in helping our country.

What else would you suggest we can do? 73

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In general, conditions look pretty good for June, with continuing high Solar Flux levels and only occasional Unsettled to Active geomagnetic field. HF in June is not quite as good as during other months, but exceptionally good VHF conditions make up for it.

Stay Tuned

As always, tune in to WWV (I use 10 MHz) at 18 minutes past any hour for the latest Solar-Terrestrial update. In the "best band to use" chart, the following parenthetical notes apply: (1) try 40 or 30 meters; (2) try 15 or 18 meters; (3) try 10 or 12 meters; (*) try 80 meters. Note that with WARC bands active, you may use 30 and 40 together; 10 and 12 together; and 17 and 20 together for openings shown on the band-time chart. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	-	-	-	-	20	20	20	-	-	-	15
ARGENTINA	15	20	20	20	-	-	-	-	-	10	10	10
AUSTRALIA	-	-	-	20	20	20	15	15	15	-	-	-
CANAL ZONE	15	15	20	20	20	-	20	20	15	10	10	10
ENGLAND	20	20	*40	-	-	20	-	15	15	20	20	20
HAWAII	15	15	15	20	20	40	20	-	-	-	15	10
INDIA	15	20	-	-	20	20		-	-	-	-	-
JAPAN	15	-		-	-	20	20	20	-	-	-	15
MEXICO	15	15	20	20	20	-	20	20	15	10	10	10
PHILIPPINES	20	15	20	20	-	-	20	-	-	-	-	-
PUERTO RICO	15	15	20	20	20	-	20	20	15	10	10	10
SOUTH AFRICA	-	-	-	20	20	-	-	15	15	15	20	20
U.S.S.R.	20	20	(1)20	20	-	-	20	-	-	15	15	20
WEST COAST	*15	*15	80	80	80	-	20	20	20	20	15	15

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	-	15	15	-	-	(1)20	20	20	20	-	-	-
ARGENTINA	15	15	20	20	-	-	-	-	-	10	10	10
AUSTRALIA	15	15	15	20	20	20	20	20	-	-	-	-
CANAL ZONE	15	15	20	20	20	20	20	20	20	15	10	10
ENGLAND	20	20	20	40	-	-	-	-	-	-	-	15
HAWAII	10	15	15	20	(1)20	(1)20	20	20	-	-	-	-
INDIA	(2)20	(2)20	-	-	-	-	20	-	-	-	-	-
JAPAN	-	15	15	-	-	(1)20	20	20	20	-	-	-
MEXICO	15	15	20	20	20	20	20	20	20	15	10	10
PHILIPPINES	20	20	15	20	-	-	-	-	-	-	-	(2)20
PUERTO RICO	15	15	20	20	20	20	20	20	20	15	10	10
SOUTH AFRICA	-	-	40	20	-	-	-	-	15	20	20	-
U.S.S.R.	20	20	20	-	-	-	-	-	-	15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	15	20	20	20	20	(1)20	20	15	20	-	15
ARGENTINA	10	15	15	20	(1)20	-	20	20	-	-	-	15
AUSTRALIA	10	10	15	15	20	20	40	40	20	-	-	-
CANAL ZONE	15	15	20	(1)20	(1)20	40	80	-	-	(3)15	(3)15	15
ENGLAND	15	20	20	20	-	-	-	20	15	15	-	15
HAWAII	15	15	15	20	20	40	40	20	-	-	15	10
INDIA	-	-	15	-	-	-	20	20	20	15	-	-
JAPAN	15	15	-	20	20	20	40	20	20	20	-	15
MEXICO	15	15	20	(1)20	(1)20	40	80	-	-	(3)15	(3)15	15
PHILIPPINES	-	-	15	-	-	20	20	20	15	15	-	-
PUERTO RICO	15	15	20	(1)20	(1)20	40	80	-	-	(3)15	(3)15	15
SOUTH AFRICA	-	-	-	20	20	-	-	20	20	15	-	-
U.S.S.R.	20	20	20	20	20	-	-	-	-	-	-	-
EAST COAST			80	80	80	-	20	20	20	20	15	15

JUNE

SUN	MON	TUE	WED	THU	FRI	SAT
				1 F–G	2 G	3 G–F
4 F	5 F–G	6 G	7 G–F	8 F–P	9 P	10 P–F
11 F–G	12 G	13 F	14 F	15 G	16 G	17 G–F
18 F	19 F–G	20 G	21 G–F	22 F–P	23 P	24 P
25 P	26 P	27 P–F	28 F	29 F–P	30 P	

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JULY 1989
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Reviews:

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AEA's FSTV transceiver

PC Electronics' 33cm ATV transmitter

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JULY 1989 Issue # 346

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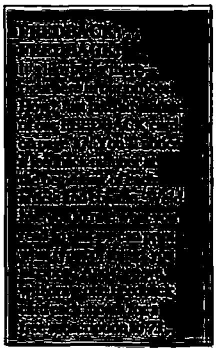

Cover: Debra Davis KA7FPL operating the AEA 430 70 cm fast-scan transceiver at Puget Sound.

Cover by Marilyn Moran

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QRM

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Welcome, Newcomers!

What's "Hot" About Microwaves

Microwaves first awed many of us (and made some of us very suspicious) with their ability to brew up a piping hot cup of coffee in 30 seconds, or cook a meal in three minutes. Now we hear more about communications associated with microwaves. Telephone companies routinely use microwave relays, and many television studios transfer their programming to the broadcast site via microwave links. The proliferation of satellite dishes in residential backyards and on homes attests to the immense popularity of satellite TV, in which signals on the microwave bands are **uplinked** to, and **downlinked** from, satellites orbiting the equator.

Do the same waves both cook and carry communications?—most certainly! Microwaves are part of the **electromagnetic wave spectrum**, which contains waves of immensely varying properties, such as X-rays, ultraviolet light, visible light, and infrared, and those that carry AM and FM broadcast signals, among others. The form of these waves, however, is exactly the same—they differ only in **frequency**. More and more **hams** are taking an interest in microwave operation. Why this is just a recent phenomenon, and what their vast potential is, is the thrust of this month's column.

Long Known About

It's a little known fact that microwave communications has existed since the very early days of radio investigation. Guglielmo Marconi, the father of wireless radio, made his first major contribution to communications technology in 1897 by sending a microwave signal that was received several miles away.[1] As early as 1933, a commercial microwave link was set up across the English channel, which operated for many years.

Why haven't more hams ventured into these bands until recently? For a combination of reasons:

- Line-of-sight **propagation**. Except during highly unusual atmospheric conditions, microwaves travel in a straight line. Waves of much lower frequencies, generally those below 30 **MHz**, usually travel to the ionosphere, which refracts them back to Earth to points many miles away.
- Specialized components. Only very precise (and expensive) components could cleanly generate such high frequencies, at appreciable power levels.
- High **attenuation**. Microwave energy is absorbed much more by organic matter than are waves of lower frequencies. Even moisture greatly absorbs microwave energy at certain frequencies in the higher end of the microwave subspectrum. It's this property that makes microwaves ideal for cooking!

Much has changed, however. Commercial interests have been developing microwave systems in earnest in the past 20 years, which has increased the supply, and driven down the cost of microwave components and instruments that use microwaves. An example of this is the microwave oven—be sure to catch the article in this issue that shows you how to convert such a beast into an amateur television transmitter!

Transponder-equipped satellites for many communication services, including amateur radio, now orbit the Earth. They greatly increase the range of line-of-sight signals, and reduce the attenuation problem, since these signals do not encounter trees, mountains, and other energy-absorbing obstacles on their way to and from the satellite.

And what do these bands have in their favor? First and foremost is the vast amount of bandspace in the microwave region allocated for amateur use—one ham band alone there contains almost as much bandspace as all the ham bands below it combined![2] This permits much **wideband** operation, which is desirable since, the wider the signal, the more quickly it can convey information. There are many **modes** of operation, too, that hams can investigate in the microwave regions that aren't allowed in the lower frequency regions due to the narrower band allocations there. An example of an interesting wideband mode is amateur fast-scan television, much like commercial TV, on which several articles are featured here this month.

A second reason is that, for comparable **gain**, microwave antennas do not need to be as large as those needed for lower frequency signals. These antennas, too, are easily made to be extremely directive, which helps reduce unnecessary interference.

Microwaves offer a unique opportunity for hams to explore new techniques and methods of operation—and more cheaply than ever before. Come and explore this frontier!...de NS1B

References

[1]*Marconi's best-known contribution to radio communications is the first transoceanic wireless transmission. In December 1901, Marconi sent the letter "S" from a site near St. John's Newfoundland, which was received in Poldhu, Cornwall.*

[2]*The 3 cm (10–10.500 GHz) band is 500 MHz wide. All the amateur bands below 3 cm to 160 meters total up to less than 510 MHz of bandspace.*

GLOSSARY

Attenuation—Dampening, reduction.

Band—A group of contiguous frequencies.

Downlink—A signal that is sent from a satellite to an Earth-based station.

Electromagnetic wave spectrum—This represents the entire range of frequencies or wavelengths of electromagnetic wave energy. Radio waves typically range from 20,000 Hz (cycles per second) to 300,000 million Hz (cycles per second). The microwave portion of the spectrum is typically set at 1,000 million–300,000 million Hz, or cycles/second.

Frequency—One of the two terms that characterizes electromagnetic waves. It is the number of cycles of a wave that passes a given point in a given period of time. (A wave cycle is the distance of the wave from one peak to the next.) The frequency is usually given in cycles per second, commonly termed **Hertz (Hz)**.

Gain—This describes the increase of voltage, current, or power. Gain is a ratio. A given transmitting antenna's gain, for example, is the strength of its radiated signals compared to the strength of the radiated signals of a reference antenna. Gain is usually represented in logarithmic units called **decibels** (dB).

Ham—Short for amateur radio operator.

MHz—Abbreviation for megahertz. This stands for "millions of cycles per second."

Mode—Mode has several meanings. In this case, it refers to the way information is imposed on a radio wave. AM and FM are two modes.

Propagation—This refers to the traveling of radio waves through a given medium, such as the atmosphere. The better the propagation, the further this energy travels through the medium.

Transponder—The unit on a satellite that receives a signal from Earth and simultaneously retransmits it back to Earth, on a frequency distant from the receive frequency.

Uplink—A signal sent from an Earth-based station to a communications satellite.

Wavelength—One of the two principal characterizations of an electromagnetic wave. The wavelength is conventionally measured from one wave peak to the next. This distance is usually given in meters or centimeters.

Wideband—Refers to a signal that occupies a relatively broad piece of spectrum. An AM broadcast signal, for example, takes up 6,000–8,000 cycles of bandspace, and is not considered very wideband. The signal that carries the combined audio and color video to your TV set, however, occupies a minimum of 6 million cycles of bandspace, making it comparatively wideband.

Number 2 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Beacons

With the gradual return of our blessed sun spots, it's getting on time to get organized with ham beacons on our higher bands. Yes, I know there are quite a few of them around the world already, but there isn't any serious organization of their efforts that I've seen.

It makes operating on our VHF and UHF bands a lot easier when there are beacon stations operating—particularly when there is an accepted standard beacon frequency on each band. Then all you have to do is tune to that channel and you'll hear when the band starts to open, and to where.

This is not exactly a new concept. Forty years ago the Radio Amateur Scientific Observations (RASO) group, organized by Perry Ferrell, set up beacon operation on 50.1 MHz. I converted an old SCR-522 transmitter to six meters and keyed it with a notched code wheel operating a microswitch, providing the beacon operation from New York City.

With ten meters opening more and more often, I'd like to see an agreed upon beacon frequency established. For ease of tuning I suggest it be on an easy-to-remember frequency, say 28.5 MHz. This would help the Novices now starting to use this band to spot openings.

Lest we have five hundred hams setting up beacons in one area, we're going to need some coordination. If I try to do it you'll just get mad at me for taking so long because I'm often away at shows, hamfests, and so on. This would seem an ideal job for a handicapped or retired ham with the time to keep records, answer the mail, and send reports for publication in *73*. Any volunteers?

Beacons are even more important on six meters, where we'll be seeing openings all around the world during the peak sun spot years. These are often short and surprising. Is 50.1 MHz still a good channel or have you a better idea?

How about two meters? It'd be nice to know when there's sporadic E, inversions, and so on. 144.1? Please advise.

And certainly we want beacon channels for 220 and 450 MHz. What are good channels?

That brings us to the beacon signals. With today's technology we won't have to rely on code wheels and microswitches. I'd like some ideas on how a large number of beacon stations around the world can use one frequency without undue interference. Identification can be automatic and fast—perhaps every few minutes to keep QRM minimal. With periodic sending it should be easy to have a receiver at the beacon station checking the channel for other beacons in between transmissions.

Our receivers can be set up to turn on a cassette recorder when a signal is received. In that way we'll have a record of the band opening whether we're home or not. There should be a way to also record the time, perhaps on the second cassette channel.

It's only a short step from this to automatic QSOs between beacon stations. If a beacon station receiver picks up another beacon during the listening period it could be programmed to call it and exchange callsigns, even with no operator present. But one step at a time—let's get some beacons organized first, then we'll worry about automatic contacts. And yes, we'll have articles in *73* on how to do all this, if you write 'em.

There, that ought to get you busy thinking. We need an international beacon coordinator, recommendations for beacon channels on each band, articles on keyers, simple ten watt rigs for this service (Why use a $1,000 synthesized transceiver to generate a ten watt one frequency signal?), identification ideas, etc. Let's get cracking on this.

Reality? What's That?

Let me see if I understand your perspective on things right. I just counted up the frequencies allocated to us by the FCC—it comes to 23,164.55 MHz. Of that, on a very good day, we're using maybe 39.55 MHz of our allocation. That comes to about 0.17% that we're actually using, about 1/500th.

Well, yes, but heck, we may need those unused frequencies in the future, right? By whom? For what? We haven't had any significant growth in over 25 years and there's none even in remote prospect ahead that I know about. We haven't invented or pioneered much since we stopped growing a generation ago—or in any other way honored our FCC charter as a "service."

We managed to virtually destroy the womb that kept us going—the thousands of school radio clubs. And now we're more interested in building monuments to our past, like the Don Wallace W6AM Museum in Palos Verdes and the Percy Maxim W1AW Museum in Newington, than we are in rebuilding the infrastructure that made our hobby possible.

Do I have it right? You are upset that the FCC is taking our virtually unused 220–222 MHz band and handing it over to UPS so we can have faster and cheaper parcel delivery? Maybe you'd like to go back to Parcel Post? And now you're getting upset over the FCC proposing to open several of our unused microwave bands to industry for radio gadgets as part of their recent Part 15 rewrite?

As I understand it, you have no plans for ever getting amateur radio growing again. You have no

Continued on page 53

QRX . . .

EDITED BY BRYAN HASTINGS NS1B

The Eleventh Hour!

Deadline for article submissions for the Home-Brew IV contest—1 July—fast approaches! Competition by now is stiff, but the rewards are great. (See below for details.) Phone Bryan at (603) 525-4201, Ex. 543 for an evaluation of your home-brew idea.

Contest Chairman Opening

***73 Magazine* is accepting applications for the position of Contest Chairman.** The duties, in brief, are: Bringing the current program up-to-date, and laying plans for future contests. Financial arrangement to be discussed. Those interested may contact Bryan NS1B at the address listed below, or phone (603) 525-4201. Ex. 543.

Feedback Card Winner

Yes, we really *do* give away a free one-year sub to a draw winner from among those who take the time to properly fill out and send in the feedback cards! Now all will learn who these lucky folks are, every month.

Just scribbling a bunch of check marks across a single row on the card, and tossing a stamp on it and mailing it in, however, does *not* qualify you. I check to see that you've invested at least a few minutes of your time to fill it out. This doesn't mean you have to read every article in the book—just thoughtfully evaluate the ones you know. Above all, write in your comments and suggestions!

We add the one-year sub onto winner's current sub.

This month's winner is: R.R. DeJongh WB7CPT. Congratulations, and thanks for your input!

What's Old is New

Research teams in the US and abroad believe that vacuum tubes are the wave of the future. These tubes under development, however, will be exceptionally small, with diameters ranging from less than a human hair to only *100 atoms* across. They are being designed to fit right on or in silicon chips. Electrons will tunnel out of the solid [illegible]ctor into the vacuum, so the tubes will operate without filaments. The electrons will move faster than they would in a semiconductor because of lack of scattering, and current densities can be higher with less resistive heating.

Among the possible uses of these vacuum microelectronic devices are radiation resistant devices that have a wide temperature tolerance, and radios that operate up to 60 GHz.

Flat CRTs of unlimited size are another possibility. They would use millions of separate microscopic electronic sources, one behind each individual pixel. The result would be extremely high resolution computer and TV screens, with high brightness and low power dissipation.

Two New 73 Departments

The amateur radio field is always in flux—products are constantly being improved, companies move, prices change, etc. Information in our articles and reviews has sometimes changed several times over by the time they get to print.

Now article and review updates have their own place. Submit these, and we will run them in "Updates," a department that debuts in the August issue. Also in "Updates," we will include corrections to those occasional errors that elude our watchful eyes!

"Ham Profiles," a monthly half-page devoted to two amateurs, will also begin in August. Hams are men and women of all ages and walks of life—and all with their own reasons for joining our broad global fraternity. Help us show this wonderful diversity to newcomers—send in a photo and a short description (150 words maximum!) of yourself or another person you think deserves a shot at a place in "Ham Profiles." We especially encourage entries from women hams, and hams in their twenties and younger.

QSL of the Month

One of our more painful tasks is rejecting outright many "QSL of the Month" submissions. To save all of us energy, go through the following checklist before submitting it:

—Is it color? We rarely, if ever, run black and white. Also, we don't reproduce silver or gold.

—Is it a postcard? We can't accept these.

—Is it obscene? Don't bother sending it. (At least don't expect us to print it!)

—Is it already a photo? Chances are that it will appear too fuzzy for print after color separation.

Uncle Wayne's QSLs

We have pulled the QSL ad from our magazine and stopped printing them for the time being. We expect to resume the service in several months, when we settle on an out-of-house printer. Stay tuned for further developments.

They'll Have Your Number!

Ever make an autopatch to a law enforcement number? After you pass your traffic, they ask your name, address, and telephone

$$ HOME-BREW IV $$

73 Magazine again invites all home-brewers to turn their hot solder into cold cash and prizes, and to get their name in print to boot. All projects have a chance to appear in the magazine, and we will handsomely reward the authors of the best of these.

Now for the bounty. Ramsey Electronics sweetened the pot from their line of frequency counters. First prize is $300, a 10-year subscription to *73*, and a CT-125 1.25 GHz frequency counter. Second prize is $150, a two-year sub, and a CT-90 600 MHz frequency counter. Third prize is $75, a two-year sub, and a CT-70 525 MHz frequency counter. All this is in addition to the payment every author receives for publishing in *73*.

Contest Rules

1. Entries must be received by 1 July 1989.
2. To enter, write an article describing your best home-brew construction project and submit it to *73*. If you've never written for *73*, send an SASE for a copy of our Writer's Guide, or download it from CompuServe (Hamnet forum, Library 0., filename "73WRIT"). *Be sure to state on the submission that it is for the Home-brew IV contest.*
3. Here's the real challenge: The total cost of your project must be under $73, even if all the parts were bought new. Be sure to include a detailed parts list with prices and sources.
4. Our technical staff will evaluate each project on the basis of originality, usefulness, reproducibility, economy of design, and clarity of presentation. The decision of the judges is final.
5. All projects must be original. That is, they must not be published elsewhere. There is no limit to the number of projects you may enter.
6. If your article is accepted, *73 Magazine* will, upon publication, purchase first North American serial rights.
8. Mail your entries to: 73 Magazine
WGE Center
Forest Rd.
Hancock NH 03449
Attn: Home-Brew IV

number. Quite often, we do not want to give that information over the air. Not doing so, however, may cast suspicion on the credibility of your information.

The way around this? Give them just your driver's license number! When the dispatcher asks, just say "Please copy my (State) DL number XXXXX." It's a good idea to write this down on your emergency autodial number card, for instant access.

Superlink

A group of Canadian hams is working hard to expand a private transcontinental radio link that will make other North American networks pale in comparison. The project is called I-PARN—the Interprovincial Amateur Radio Network. I-PARN is projected to be a full-time Canada-wide network for both voice and digital communications.

What separates I-PARN from links like the Condor connection in California or the Zia Connection in the southwestern US is both the scope of its coverage and the type of linking. I-PARN will link repeaters using ground stations and commercial geostationary communications satellites! Once in place, this network will permit amateurs in any major city in Canada to speak at leisure with their counterparts in other population areas with only a two meter HT.

I-PARN is conducting a membership drive across Canada to get funding to complete the network. Hams in the lower 48 states shouldn't get their hopes up, however, as there are no plans to extend I-PARN south of the border.

Be Kind to Your Low-Power Friends

QRP and QROers alike take note of the following list of HF QRP frequencies: 1.810, 3.560, 7.030-7.040, 10.106, 14.060, 21.060, and 28.060 MHz. Kilowatters, please give these frequencies as wide a berth as possible.

QRPers' Delight

The British journal *New Scientist* recently published an article on a newly developed superconducting antenna (Oct. 29, 1988, page 38). It states that engineers at the University of Birmingham, England, made an antenna that radiates virtually all the energy it receives when properly loaded. The experiment was conducted with a dipole made from the new high temperature superconductor: yttrium-barium-copper oxide. The gain at 550 MHz was 16 times that of a copper antenna of equal length operating at room temperature.

FCC Just Says "No."

The FCC Commissioners upheld the Private Radio Bureau's decision denying a request from Anthony Sivo W2FJ to amend the amateur rules to authorize single sideband in the 30 meter band. The Commissioners agreed with the Bureau's conclusion that the need for SSB transmissions in the 30 meter band had not been established and there were already ample frequencies available for sideband operations.

The FCC also denied RM-6559. This one would have allowed Technician class operators to use teleprinting and packet in the Novice and Technician segments of the 80, 40, and 15 meter bands. The petitioner, Nicholas Sayer N6QQQ said that the additional privilege for Technician operators would be an incentive for Novice operators to upgrade. The Commission countered that the Technician class is currently the fastest growing amateur license, and there was no need to offer additional incentives for Novice class operators to upgrade to the Tech.

And finally, the FCC's Private Radio Bureau denied a petition by Shannon Cisco WB4AZT to change the amateur operator license requirements for senior citizens. Cisco had requested that amateurs over 65, licensed for 20 years, be automatically upgraded from Technician to General, General to Advanced, or Advanced to Extra Class respectively, without any further testing. Cisco's original request had been denied. He appealed the Order to the FCC Commissioners, who upheld the Private Radio Bureau's decision.

Electronic Road Maps

Electronic road maps are already available in California ($1,400) which not only tell you where you are, but the best way to get to your destination. An arrow marks your car's position on a green street grid on a 4.5" dashboard monitor. As the car moves, the map display moves with it, rotating as the car turns to match what you see through the windshield. A personal computer in the trunk controls the system.

Soon to be marketed are radar guided systems to detect and avoid obstacles, communications devices that provide real-time traffic information, and smart cruise controls that sense when there is a vehicle ahead, so that you can maintain a safe distance.

Who's 9G1R?

The Japan Amateur Radio League (JARL) receives a considerable amount of QSLs for a station that claims to be 9G1R. Please don't send JARL your card for this station—they do not have any QSL routing info for it.

17m WAS

The first 17 meter Worked All States award has been issued to Christopher Merchant KA1LMR on 1 March, after Chris became the first to submit his cards to the ARRL headquarters.

Speakers' Bureau

Westlink Report in California recently created a Speakers' Bureau. The Bureau will act as a clearing house for the expertise of speakers willing to attend conventions and hamfests and make presentations in their specialties without any honoraria. Groups requesting a speaker must provide transportation (of the speaker's choice), lodging, meals, and any miscellaneous expenses incurred by the speaker.

The following people are currently available:

—Phil Anderson WØXI, President of Kantronics, Inc., 1202 E. 23 Street, Lawrence KS 66046. Area of expertise: digital communications.

—Chod Harris VP2ML, Editor of *The DX Bulletin*, Fulton, California. His address is PO Box 4881, Santa Rosa CA 95402. Chod has four prepared talks dealing with DX: Christmas and Easter Islands, The Galapagos, African Odyssey, and how the *DX Bulletin* is published.

—Bill Pasternak WA6ITF, 28197 Robin Ave., Saugus CA 91350. Areas of expertise: amateur radio promotion, television production, broadcast/consumer VCR/VTR maintenance, VHF/UHF repeaters, and frequency coordination.

—Bill Waters WA6OLW, 825 La Crosse Ct., Sunnyvale CA 94087. Bill is the former Operations Manager of Sunnyvale USAF Satellite Test Center and is a Communications Engineer with Ford Aerospace. Areas of expertise: antenna experimentation, microwave hardware development, propagation, and low-noise systems.

Please contact the speaker you want directly at the address listed. Potential speakers are urged to join this service at no cost.

Thanks . . .

To all those who contributed to this month's QRX column. They are: *Westlink, JARL, W4CA Log*, and N5KOB Keep sending in those photos and news items! Address them to: *73 Magazine*, Forest Rd., Hancock, NH 03449, Attn: QRX.

10 Meter Survival Guide

Check out this "most-moded" HF band!

by Chuck Scott N8DNX

If you think 10 meters is just another ham band, you're in for quite a surprise. After a long period of poor propagation and relative neglect, this band has come alive with a vengeance. The combined forces of Novice Enhancement, new transmission modes, a flood of equipment, and what may be the best solar cycle yet, are beating on the door of ham radio. Are you ready?

10 Meter Band Plan

The FCC rules and regulations give us the official word on band use. But there's more to the story. By general agreement, and some prodding by various organizations, the band has been divided into a maze of allocations and sub-bands. (See Figure 1.) Knowing and following these voluntary assignments can make you a more efficient and courteous operator. More than that, knowing what's there, and where to find it, can only add to your enjoyment.

When is Ten Open?

Before you call CQ, find out which parts of the world are open to your QTH by scanning the area from 28.190 to 28.300 MHz. The propagation beacons found there will frequently surprise you. Check your Callbook or page 103 of the Jan '88 *73* for a list of 10 meter beacons. One beacon of particular interest is the IY4M robot on 28.195 MHz. Try giving it a call sometime.

In the future, expect an integrated beacon system to begin operating in a round robin fashion near 28.200 MHz. A similar system has been in operation for some time on 14.100 MHz.

These beacons generally run with very low power (some less than a Watt!) and you can often hear them when the rest of the band sounds dead. Perhaps this should be a lesson to those who question CW's ability to get through during marginal band conditions!

Speaking of CW

Having been inspired by low-power beacons, you should go QRP and tune around the 28.040 or 28.060 MHz calling frequencies for low power operations. Be warned, though: Some of these guys consider real QRP to be anything under 100 mW!

By comparison, a Novice or Technician can be a real powerhouse on 10 CW with ample opportunity for exciting DX. Just take note of the two popular packet frequencies in this area.

Digital Modes

Most packet activity on 10 meters is centered around two frequencies. Check 28.105 MHz for 300 baud operation or 28.205 MHz for 1200 baud. One important note, FM packet is not allowed on the 10 meter band below 29.2 MHz.

RTTY and AMTOR enthusiasts should look at the region of 28.090 to 28.100 MHz.

The Flood Gates are Open

Depending on your point of view, Novice Enhancement is either something unmentionable or a real boon for the hobby. Whatever you think, a quick scan across the Novice/Technician SSB portion of the band when 10 meters is open is a real eye-opener. An influx of economical new radios, and a wave of the FCC's hand, have moved the bulk of the SSB activity down below 28.500 MHz. Low power mobiles and stations with very modest antennas can easily pick up QSOs in this region.

While there isn't a real standard yet, 28.400 MHz is a good gathering place for mobiles to pick up QSOs. If the frequency starts getting busy, move your contacts down away from this calling frequency.

If you think it takes a full "gallon and a half" to bust into a DX pileup, you should try again. On 10 meters, any station can catch a rare one by using courtesy and persistence, even low power mobiles! Listen to what's happening and try to figure out what catches the DX station's ears.

Moving up the Band

The middle of the General phone band is home to some big time rag-chewing—try calling around 28.600 MHz. Look for SSTV activity between 28.675 and 28.685 MHz, or on 28.945, if you're into FAX. Another interesting feature is the continuous code practice transmission at 28.888 MHz which comes from W6IRT's QTH (N. Hollywood, CA) running only 5 Watts into a ground plane antenna.

AM operation has a frontier outpost between 29.000 and 29.200 MHz, with 29.000 being a common calling frequency. Many modern radios are equipped with this mode, including the popular Uniden HR-2510. With this kind of backing, 10 AM should see a significant increase in popularity.

Rugby and 10 FM

To the newcomer, both rugby and 10 FM seem uncivilized with few survivors. Well, maybe that's true about rugby, but 10 FM can have a more dignified manner. Occasionally referred to as the Channel 19 of amateur radio, the FM calling frequency of 29.600 MHz has earned its reputation. As you listen in, you might be surprised by the "no holds barred" activity.

Part of the problem is a proliferation of "links," secondary transceivers connected to VHF and UHF repeater systems. Some of these operate exclusively on this channel. Rarely out of control, but sometimes innocently left on, they faithfully retransmit the activity of their parent repeater. Users of these links should take extra caution to ensure their proper operation, and configure them without courtesy tones or hang time. A properly operated link can be exciting for repeater users. Link owners should add to that excitement with at least one more frequency to which they can QSY.

With such heavy congestion on the calling frequency, stations need to move off quickly and continue their QSO elsewhere. The best place to QSY is 29.200 to 29.300 MHz, where you can also find a common DX calling frequency. The reason for going so far down the band is to avoid interference with repeater inputs and outputs and satellite downlinks. Keep in mind that a 10 meter FM signal is about 10 kHz wide. FM signals can easily interfere with an FM receiver 10 kHz away, or totally obliterate a CW or SSB signal 5 to 8 kHz away. 10 meter FM operation is quite channelized—stick to the even numbered 10 kHz channels (i.e., 29.220, 29.240...) to avoid problems.

Repeater operation on 10 meters is nothing like its VHF or UHF counterpart. Frequent propagation over large areas, and only four available repeater pairs, often result in many repeaters being heard on the same frequency. Use your best judgment to avoid keying up repeaters which may interfere with ongoing QSOs. I think in the future we will see some solutions, perhaps PL. In the meantime, keep up with 10 meter repeater activity

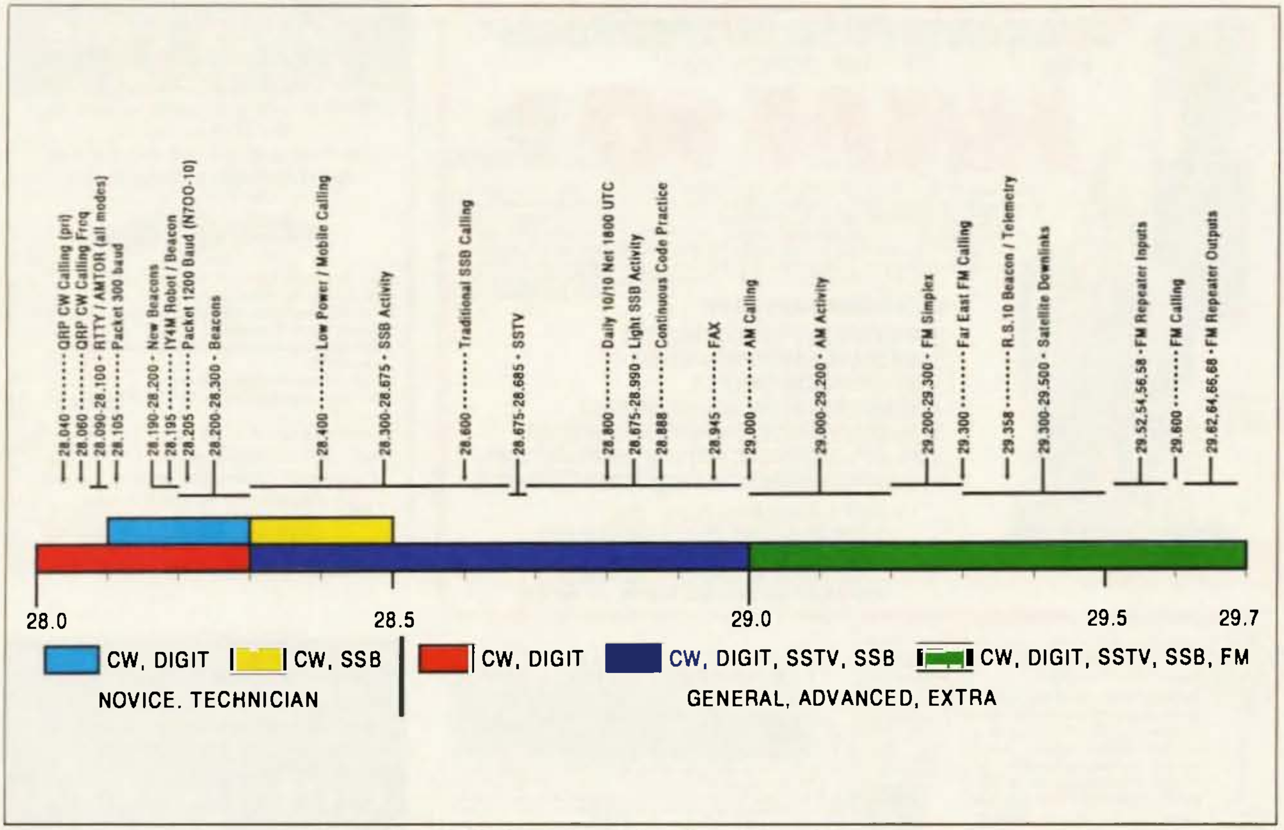


Figure 1. Mode and license class allocations for 10 meters.

by joining the Ann Arbor 10 meter Repeater Net on 29.54/64, Monday evenings at 0000 UTC.

Satellites, Too

Downlinks located between 28.300 and 28.500 MHz are paired with uplinks on other bands. Since satellite operators aren't transmitting on 10 meters, they often can't tell you that you're interfering with them. Even though RS-10/11 seems to be all that's active at this time, more satellites are expected to use 10 meters. Listen around 29.358 MHz for the RS beacon and telemetry. When you hear it, tune up toward 28.400 MHz for the downlink passband.

Ten meters is frequented by a number of contests and regular nets. The familiar sound of "CQ TEN TEN" is the result of Ten-Ten International, which currently conducts a daily net on 28.800 MHz at 1800 UTC. They sponsor numerous awards and in the process have helped keep the 10 meter band active during long periods of poor propagation. Ten-Ten International boasts nearly 50,000 members.

It's easy to see why 10 meters is rapidly becoming a showplace for amateur radio. Solar Cycle 22 is providing 10 meter openings to all parts of the world, inspiring new hams and old-timers alike. Novice Enhancement, inexpensive radios, relatively small antennas, excellent propagation, and a wide range of active modes, provide the excitement. Courteous operation and understanding of the voluntary band plan make it work. Now that you know where the action is, enjoy it! ■

For More Information, Contact. . .

Satellite Operation AMSAT N.A PO Box 27 Washington DC 20044	**AM** AM Press Exchange 2116 Old Dover Dr. Woodlawn TN 37191
Packet TAPR PO Box 22888 Tucson AZ 85743-2888	**Ten-Ten International** 18130 Bromley St. Tarzana, CA 91356
VADCG 9531 Odlin Rd. Richmond, BC V6X-1E1 Canada	

Inexpensive Hardline

Easy conversion of 75Ω CATV hardline for 50Ω systems.

by Edward Krome KA9LNV

Like many hams, I always look for new facets of the amateur radio hobby to explore. This exploration tends towards the higher and higher bands, especially the microwave bands, where wide ham allocations allow for experimentation with a variety of modes. This article describes an easy way to overcome one of the hardware hurdles in UHF and above operation—the expense of low-loss cable.

The Problem

My latest project has been Mode L operation on AMSAT-OSCAR-13. Mode L uses a 23 cm uplink and a 70 cm downlink. I recently built up equipment for the 1269 MHz uplink, but found the strength of my signal less than what I would like. I only have about 13 Watts of power and a single 45-element loop yagi on that band. This should be adequate, but that 13 Watts must actually be at the antenna feedpoint rather than in the shack looking at a lot of cable. At 23 cm, even the best "standard" coaxial cable is not very good. Good quality RG-8 has 10 dB attenuation per 100 feet and is almost unusable. Even Belden 9913, considered about the best available, gives almost 6 dB loss per 100 feet. Losing 6 dB means that only one quarter of what you put into the cable actually comes out 100 feet later. As anyone who has ever acquired 23 cm equipment will tell you, those are pretty expensive Watts to heat cable with!

Finding an Answer

Increasing signal strength boils down to either increasing the power out or decreasing antenna system loss. I decided to concentrate on line loss. My investigation of really good cable (such as ⅞-inch 50Ω Heliax, at almost $5 per foot with $55 connectors) left me cold. After all, my children do have to eat.

Soon, however, a readily available cable caught my eye—the ¾-inch diameter aluminum-jacketed hardline used for CATV. This cable has some great properties—it loses less than 3 dB per 100 feet at 1.2 GHz, and it's inexpensive (usually free or nominal). It has, however, two main drawbacks: it's a 75Ω line (which matches nothing commonly used in ham applications), and poses mechanical problems with its aluminum jacket and copper-coated aluminum center conductor that tax the ingenuity of the home-brewer. This article shows you how to overcome these two problems.

Where To Get CATV Cable

CATV companies buy this cable in huge rolls. Time economies and signal considerations mean that they will frequently either sell or give away roll ends too short for their use. These roll ends can be quite long by amateur standards—one I was given contained almost 500 feet of brand new cable! Polite inquiries with the local CATV companies are a good place to start.

Electrical Requirements

According to the *ARRL Handbook* and *Antenna Book* (Transmission Line section, any recent year), all you have to do to use cable of one impedance in a system of differing impedance is to match the two impedances with a quarter-wave impedance transformer. This is just a section of transmission line whose impedance is equal to the square root of the product of the two impedances you are trying to match, and cut to one quarter of the free space wavelength at the frequency of interest. That's all! In equation form, the required matching impedance Z_{im} is:

$$Z_{im} = \sqrt{50\Omega \times 75\Omega} = 61.2\Omega$$

So, in order to use 75Ω line in a 50Ω system, you must add a 61.2Ω impedance matching section to each end of the 75Ω line.

The *Handbook* also tells you how to construct a coaxial line. The impedance of an air-insulated coaxial line is determined by:

$$Z = 138 \log (ID/OD)$$

ID is inner diameter of the outer conductor, and OD is outer diameter of the inner conductor. Rearranging, for Z = 61.2Ω, any combination of tubing with an ID/OD ratio of 2.776 will provide the required impedance.

There's been a number of impedance converters published in amateur literature, but most use "non-standard" materials. "Standard" is what you can buy in a hardware store or plumbing shop. I devised a Z-matching device using a readily-available material—¾-inch copper pipe.

This copper pipe, in its most common form, is actually 0.875 inch in outside diameter and has a 0.032-inch wall. This yields a 0.810-inch inside diameter. Looking at the ID/OD requirements, the closest available standard hobby brass tube for an inner conductor is 9/32 (0.281)-inch diameter. Plugging these dimensions into the above formula gives an impedance of 63.4Ω. It's unlikely this variance from the actual requirements for a perfect impedance match would seriously degrade the performance. A purist could silver-plate the brass up to 0.292-inch OD and be exact.

You determine the length of the quarter wave section by the frequency desired. Since these devices are quite broadband, one length covers a given band. The 1296 MHz version, for example, works well on 1269 MHz. From the formula for free space wavelength, which also applies to air-insulated transmission lines:

¼ wavelength (feet) = 246 / F (MHz)

or

¼ wavelength (inches) = 2952 / F (MHz)

Interestingly, since 2 meters, 70 cm, and 23 cm are all harmonically related, and one quarter wave on 2 meters equals three quar-

Continued on page 18

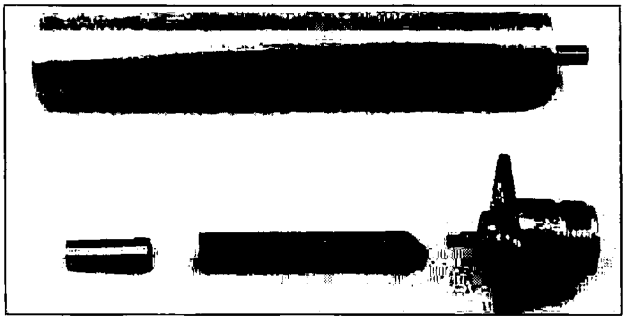


Photo A. Parts required for a single impedance converter. Note the spacer sleeve and outer shell (top row), and the center contact, center conductor with necked-down end, and the UG-58 (type "N") coaxial connector. The screw clamp is not shown.

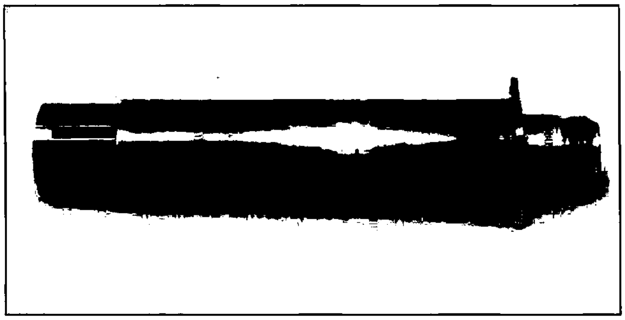


Photo B. Complete 23 cm impedance converter in process of being assembled to ¾-inch CATV hardline. Assembly will be complete when spacer sleeve is pressed in place between the outer shell and the hardline itself, and the screw clamp is installed.

Continued from page 16

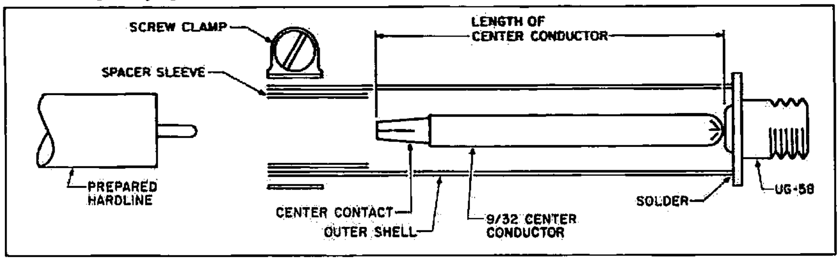


Figure 1. Cutaway of ¼ wave impedance converter, showing all parts of the completed unit.

ters on 432 MHz and nine quarters on 1296 MHz, you could theoretically use a single line and set of 2-meter impedance converters for all three bands. There are a few problems, however, with this "one line and matcher fits all." First, the more quarter wavelengths you use, the narrower the frequency response becomes, and the more likely that your impedance matching sections will become attenuators if they are not right on the money. Second, a single feedline precludes full-duplex crossband operation required for satellite work. Finally, at those frequencies, the cost of remote mounted antenna switching relays would far exceed the cost of separate feedlines!

Construction

The following construction plans appear to be the easiest 50Ω to 75Ω impedance matching arrangement to duplicate, using the most common materials I've run across. Although this project was originally intended for Mode L uplink use only, Table 1 includes dimensions for all popular VHF/UHF bands.

Parts

Build two identical units for each cable.

•Outer Conductor: Standard ¾-inch copper pipe, available at any plumbing supply house or hardware store. Insure that it actually measures ⅞" (0.875") outside diameter and has a 0.032" wall thickness.

•Inner Conductor: Hobby brass tubing measuring 9/32" (0.281") outside diameter. Miscellaneous sizes of brass tubing and assorted shapes are available in many hardware stores and model shops. These are typically stocked in 12-inch lengths. Where longer pieces are required, buy two 12-inch lengths for each converter and slip a 4-inch length of the next smaller size inside, then solder them together. Be sure the assembly is straight.

•Coaxial Connector: You can get away with using the UHF type (SO-239) connector at 2 meters, although it is not ideal. At any higher frequency, always use high quality Teflon™ and silver N connectors, normally designated UG-58/U. These connectors cost $3–5 each new, but if you are going to go to the trouble of building equipment for these bands, it is false economy to use cheap connectors. Also, stay away from the inexpensive bright nickel plated ones, as they will corrode, and usually do not have insulators capable of tolerating the soldering heat required for assembling these impedance converters. It's depressing to watch the center melt and drop out of a connector as you attempt to solder the flange.

Good used UG-58s are widely available at hamfests and surplus outlets. A good cleaning in the dishwasher and the use of a used (soft) Scotch-Brite™ cleaning pad does wonders. Stay away from cleaning with steel wool, as you'll leave brass where silver used to be! Also, steel wool has the bad habit of leaving little electrically-conductive strands in the least noticeable places.

•Center Contact: Since the center conductor of the CATV hardline is copper-coated aluminum, you will need some form of finger connector for positive contact. The most elegant solution I have seen was published by Bill Olson W3HQT in his ">50" column for *QEX* magazine in March, 1988. Bill used the double female center pin removed from a UHF "T" connector, cut in half to provide two sets of fingers for two impedance converters that just fit the hardline center conductor.

•Miscellaneous:

Silver hobby solder. This is a high-strength, low-temperature solder available at most hardware and hobby stores. Silver solder resists corrosion in outdoor service, and is reputed to provide better conductivity to RF than its ordinary lead-tin relative. It has separate solder and flux.

Hose clamps. Use stainless steel, screw types. One for each impedance converter.

Hand tools. Include a tubing cutter, hacksaw, small triangular file, and small steel square for alignment. Also, a small pencil torch is much easier to use than a regular propane torch.

No **Al Ox™**, or similar compound for preventing corrosion between the aluminum outer jacket of the hardline and the copper impedance converter. Available at electrical supply houses.

A soldering and assembly fixture, made by drilling an 11/16-inch hole, ¾ inch deep in a wood board. Not absolutely necessary, but sure beats trying to hold a hot connector in your fingers.

Parts Preparation

•Center Contacts:

Disassemble the UHF T connector by grasping the male connector center pin with vise grips and unscrewing it counterclockwise. Drive the double female center conductor out of the end of the connector. Note that some T connectors have a slight crimp on one end, so gently drive the pin out the opposite end. Discard all pieces except the double female pin. Saw the double female in half to make two center contacts, one for each end of your hardline system.

Fit the end of the contact opposite the fingers to the 9/32 center conductor tube. It may well be a perfect, tight fit. If not, turn the outside diameter of the solid end to fit the 9/32 tube tightly. It is best to use a lathe, but you can do a satisfactory job by chucking the pin in the chuck of a drill clamped in a vise and "turning" it with a file. When clamping the contact in the drill chuck, slide it in far enough for the jaws to contact the solid part, not the fingers. Be careful. Turning down a 1/16 to ⅛-inch length is adequate since the contact and the center tube conductor will be soldered together. Set the prepared pins aside for later assembly.

•Center Conductor:

One end of the 9/32-inch tube center conductor must be necked down to the ⅛ inch diameter of the solder pin on the UG-58. Do this before you cut the tube to length, so that if you goof, you can cut the end off and try again.

First, clean the tube and insure that one end is square. Scribe a mark around the tube 3/32 inch from the end. Then, cut eight equally spaced slots in the end of the tube to the 3/32 line. With the small triangular file, file each slot slightly to create eight equal fingers that each taper to about 1/16 inch at the outer ends. Remove all burrs. Gently bend each finger inward a little at a time until you have a ⅛-inch hole in the center. Be patient. Check the fit on the center pin of the UG-58. When you are satisfied, clean and tin the end lightly with the silver solder and flux.

Now assemble the UG-58 and the center conductor. Place the connector, threaded end down, into the hole in the "assembly fixture." Tin the connector pin. Heat the necked-down end of the center conductor and slip it over the connector pin, then solder the two together. While the joint is still hot, use the steel square to insure that the center conductor is perpendicular to the flange of the connector in all planes. Hold the piece until it cools.

Next, lay the previously-prepared center contact pin next to the soldered center conductor and connector assembly. Measuring from the insulator on the UG-58 out to the end of the center contact pin fingers, set the overall length to that required by the frequency of interest. Mark the center conductor tube so that, when cut and pressed together with the center contact pin, it will be the right length. Cut the 9/32 tube. Clean and deburr the end. Put some flux on it and press the center pin into the end of the tube. Recheck the overall length, then solder. Remove all traces of flux with alcohol.

•Outer Conductor:

Standard ¾-inch copper pipe with its 0.032" wall is almost exactly 0.065" larger than the outside diameter of the jacket on the ¾-inch hardline. So, we need to prepare a spacer sleeve to match the two diameters. First, square one end of a piece of copper pipe, then clean and deburr it. Now, with a tubing cutter, cut off a 1-inch long section. This length will be the spacer sleeve. Now mark and saw a ¼-inch wide section lengthwise from the side of this sleeve. Deburr the cut, then compress the sleeve evenly until it will just start into the end of the uncut copper pipe.

Clean the uncut outer conductor and remove the ridge left by the tubing cutter from the inside end. Slot the end of the pipe in 4 places, to ½ inch from the end of the tube. Deburr.

Cut the outer conductor to length with the tubing cutter as specified in Table 1 for the band desired.

•Final Assembly:

Stand the previously-prepared center section on end in the hole in the "assembly fixture." You will soon be glad that you made this fixture. Lightly flux the flange of the UG-58 and the unslotted end of the outer conductor. Stand the outer conductor on the flange and center it. Look in the opposite end of the assembly and insure that the center contact pin is well aligned in the center of the outer conductor. If not, this is your last chance to fix it. When alignment is correct, heat the outer conductor and flange until the flux bubbles, then touch the solder to the surfaces. When the heat is right, the solder will flow between the parts. Use enough solder to get a strong, complete bond between the parts. Do not disturb the assembly until it cools. Then, clean all flux away with alcohol. The converters are now complete and ready for assembly to the hardline.

Frequency (MHz)	Length of center conductor. (inches)	Length of outer shell (inches)
144	20.5	21⅝
432	6.83	8
902	3.27	4⅜
1296	2.27	3⅜

Table 1.

Hardline Preparation

Completely install the hardline without the impedance converters. Keep any bends as large as possible. To avoid kinking the line, I have found it helpful to cut radius forms from wood, and then bend the line over them. A 10-inch radius seems adequate.

Cut the hardline with a hacksaw. Then score the aluminum outside jacket with the tubing cutter back ½ inch from the end. Grasp the end of the hardline jacket with pliers and rock it gently to break the jacket at the score. Remove the end section of the jacket. Cut through the foam insulation to the center conductor with a sharp knife, flush with the end of the outer jacket. Do not nick the center conductor. Twist and pull off the section of insulation, then scrape the center conductor clean but do not damage the copper coating. Trim the end of the center conductor to protrude ⅜ inch beyond the foam insulation. Round the end with a file.

Clean the outside of the aluminum jacket with a Scotch Brite pad and alcohol. Since copper and aluminum clamped together are subject to galvanic corrosion (and aluminum oxide is a dandy insulator), lightly coat the newly cleaned aluminum surface with No Al Ox.

Assembly

Start the split copper spacer sleeve into the slotted end of the impedance converter outer conductor. Slide the impedance converter over the prepared hardline, insuring that the hardline center conductor enters the center contact pin. Slide them together as far as possible. The end of the contact pin should butt against the hardline dielectric. Then tap the spacer sleeve between the two surfaces until it is flush with the slotted end of the outer conductor. Secure with a hose clamp. That's all it takes! Be sure to waterproof the assembly for outdoor use.

Performance

While I lack access to the equipment required to accurately measure return loss, experiments with a directional coupler indicate no perceptible difference in SWR whether the measurement is taken at the input or output end of an assembly of two impedance converters and 50 feet of 75Ω CATV hardline. In practice, they work great. I use this arrangement on 144, 432 and 1296 MHz. On 23 cm, the bandwidth is broad enough to make no performance difference between use on 1296 terrestrial and 1269 satellite. And the reduction in line loss on Mode L satellite uplink is so dramatic that it has made a signal that was, with 13 Watts into 50 feet of Belden 9913, barely readable on SSB, to a quite satisfactory signal.

This simple project is bound to save you many dollars on low-loss transmission line cable. Good luck! ■

73 Review *by Ron Hranac N0IVN, Doug Greene NQ9I, and Bill Brown WB8ELK*

AEA FSTV-430

The latest entry into the 70cm ATV transceiver market.

Advanced Electronics Applications, Inc.
PO Box C-2160
Lynnwood, WA 96036
PH: (206) 775-7373
Price Ciass: $500

Fast-scan amateur television (ATV) is a fascinating mode of ham radio. ATV is much like commercial TV—Images are displayed at 30 frames per second, resulting in video that constantly and fluidly changes to the human eye. Compare this to slow-scan TV (SSTV), in which images are displayed only once every 8–9 seconds.

Video images are "information rich," and so it takes a large signal bandwidth to send frames of video at an appreciable rate. That's why you find ATV only in the UHF and above bands—it's only in these regions where you are allowed signals with the required bandwidths for ATV.

A very popular band for ATV is 70cm. This review addresses a new ATV transceiver on the market for this band, the AEA FSTV-430.

Panel Controls and Ports

The AEA is housed in a well-shielded and attractive case and has front panel controls for adjusting video and audio gain. You can plug the AEA into your TV camera with a 10-pin front panel connector, and switch video sources, between TV camera, VCR, and computer. To conserve power, you can also switch the camera off when you're using other video sources.

Crystal and VFO

You can order this transceiver with one or two of the popular ATV frequencies (434, 439.25, 426.25, 421.25 MHz). It produces the final signal by generating a Channel 3 or Channel 4 TV IF frequency, and then upconverting by mixing this with a crystal controlled local oscillator (LO). The same LO and mixer circuitry receives ATV. As a result, the two selected frequencies are crystal controlled also on receive. As long as the other station is on one of these same frequencies, no tuning is necessary.

A favorable feature of the FSTV 430, however, is that it also includes a variable tuning control for the entire ATV band. A switch disables the crystal controlled local oscillator and enables the VFO.

The receive IF frequency can be either Channel 3 or 4 on your TV, depending on whether there's a strong commercial station nearby. Changing the IF involves installing new crystals and moving two jumpers. The transmitted signal, basically the output of the Channel 3 or 4 modulator before upconversion, can be monitored directly on Channel 3 or 4. Although it's better to actually sample the final output as long as the output stages are linear, this will still give you a good indication of your transmitted signal.

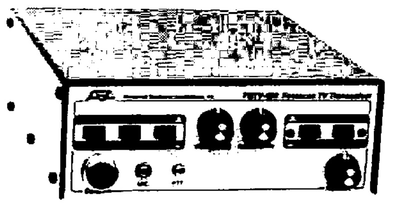


Photo A. Front panel of the AEA FSTV-430.

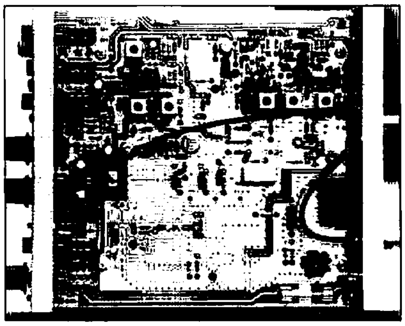


Photo B. Top of the PC board of the AEA FSTV-430. Layout is very neat.

> *"... the FSTV 430... also includes a variable tuning control for the entire ATV band."*

This rig has a built-in vestigial sideband filter, which rolls off the lower sideband of the transmitted signal 1.25 MHz below the video carrier. It eliminates emissions below the band edge on 421.25 MHz, and weak signal or satellite bands on the other frequencies. (See sidebar for discussion of vestigial sideband.)

Operation

When we made several on-the-air mobile ATV tests, most stations commented on the excellent quality of the picture. Several stations mentioned that even with a weak (P2–P3) signal, they heard a good sound subcarrier, even though the audio gain was a little lower than some of the other rigs on the market. One factor to consider when operating mobile or with battery packs, is that a rig's performance drops off considerably below 12 volts. Also the current drain of 300 mA on receive and 700 mA on transmit will mean that the battery pack should be selected accordingly, and preferably have an extra cell for 13.8 volt operation.

Receiver Performance

[Ron N0IVN performed the following measurements . .Ed]

The FSTV-430 uses a low noise front end. Received 70 cm ATV signals are amplified and routed to a diplexer that is part of the transmit/receive IF stage (see Figure 1). The signals are then amplified and applied to a mixer for downconversion to IF. After additional amplification, a second diplexer routes the IF (Channel 3 or 4) to a vestigial sideband SAW filter. This filtered channel is available at the rear panel TV F connector for display on a conventional television set.

I measured the downconversion gain vs. noise figure at the FSTV-430's TV output at four different settings: receiver tune at crystal control position, and receiver tune at low end, midrange, and high end of the VFO range. Downconversion gain ranged from 10.5 (VFO high end) to 12.3 dB (crystal setting), and receiver noise runs 2.2 (crystal setting) to 2.8 dB (VFO high end). All observations here were taken at the video carrier frequency.

Downconverted frequency accuracy was quite good: a 434.000 MHz input signal produced a Channel 3 output at 61.2527 MHz.

Most television sets will have excellent picture quality with a 1,000 microvolt RF input. The AEA transceiver will provide that signal level at its TV connector with a received RF input of about 225 microvolts; signals above

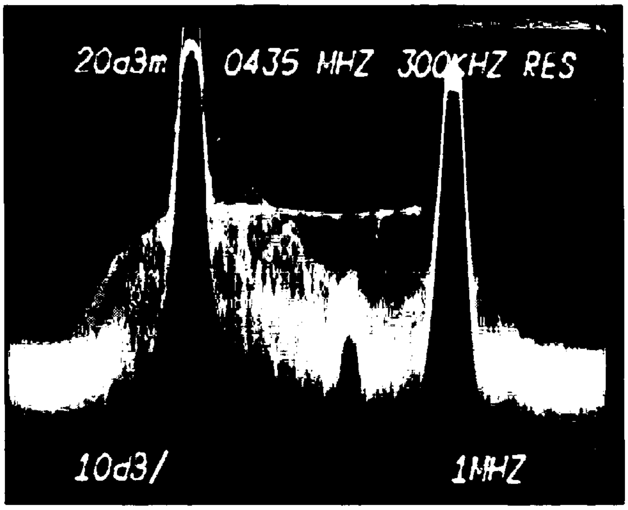


Photo C. In-channel frequency response of transmitted signal.

Photo D. Unmodulated transmitter output. The vertical scale is 10 dB/division; the horizontal scale is 2 MHz/division. The video carrier is at full vertical scale. The audio carrier is 4.5 MHz up from the video carrier, and is about 17 dB below the video carrier. The other peaks are spurious outputs.

about 2,800 microvolts will begin to overload the FSTV-430's front end. The minimum signal necessary to produce 40 dB video signal-to-noise is 147 microvolts; picture quality at that point is roughly equal to a standard VHS videotape.

Receiver current draw at 13.8 volts was measured at 0.30 amps.

Transmitter Performance

The transmitter's video input signal, from either the front panel 10-pin CAMERA connector or the rear panel VIDEO IN connector, is amplified and its sync pulses expanded before modulation (Figure 1). The audio input signal is also amplified, then the two are combined in the modulator stage. At this point, the video signal becomes an amplitude modulated IF at either Channel 3

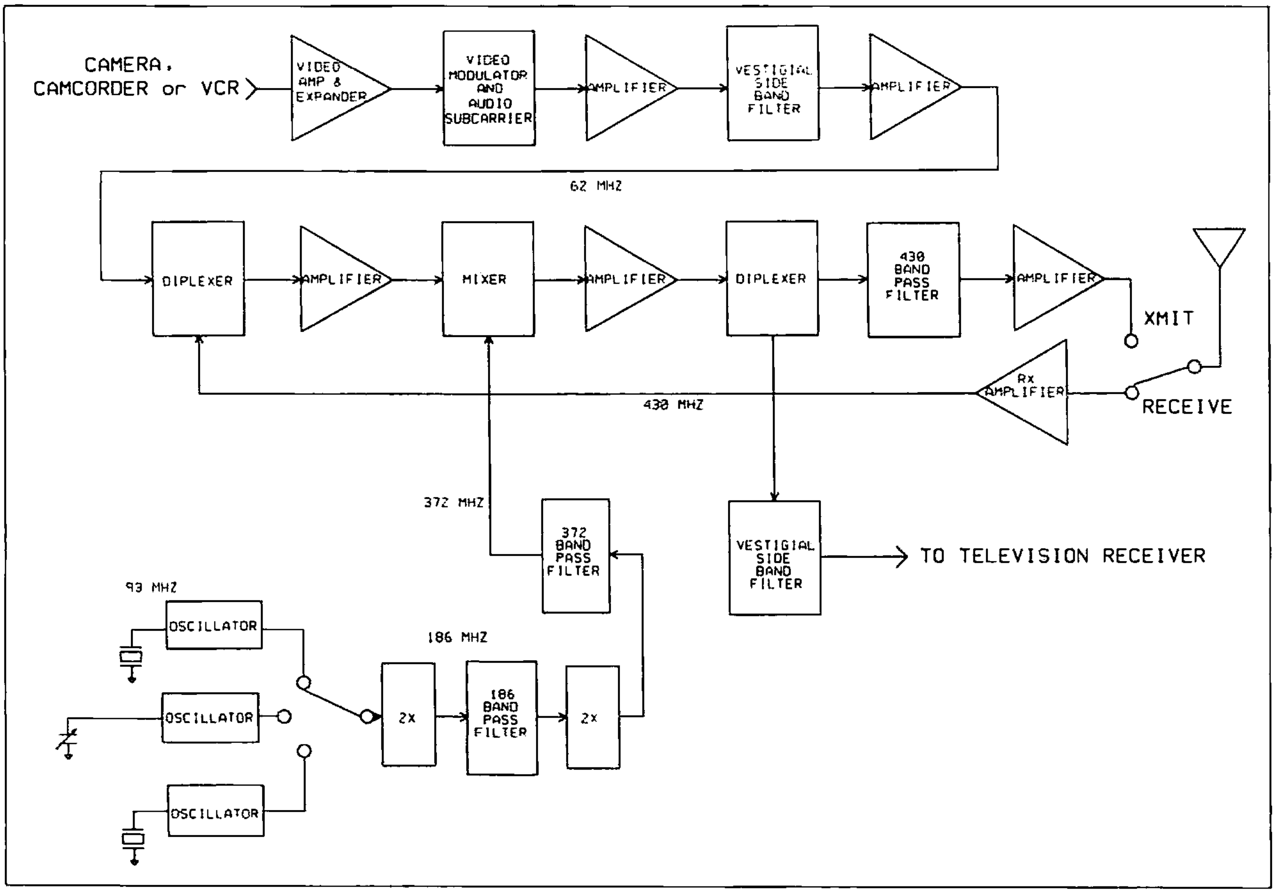


Figure 1. AEA FSTV-430 block diagram.

(61.25 MHz) or Channel 4 (67.25 MHz); the audio signal frequency modulates a subcarrier located 4.5 MHz above the user-selected IF video carrier.

The IF is upconverted to the desired 70 cm ATV frequency (434 MHz standard) and amplified to 1 Watt. The transmitter IF also is available at the transceiver's rear panel F connector for monitoring on a conventional television set.

Transmitter video carrier output power with no modulation present was measured at +31 dBm (1.26 Watts); with 1 volt peak-to-peak video input and the video gain control set at maximum (75% depth of modulation), the output power at sync tips increased 1 dB to 1.58 Watts. At this output level, the audio carrier was 18 dB below the video carrier. Curiously, after a few minutes of operation, the transmitter's output power dropped to +29 dBm (0.79 Watts). Paralleling this decrease in output power was an increase in the transceiver's operating current, from 0.72 amps when the transmitter was first turned on to 1.01 amps after several minutes of operation.

In-channel video frequency response was ±1 dB (Photo C) at 75% depth of modulation. Although the FSTV-430 uses vestigial sideband filtering in the IF, output amplifier nonlinearities introduce some third order distortions that appear as spurious signals 4.5 MHz below the video carrier and 4.5 MHz above the audio carrier. These signals were 34 dB and 43 dB below the video carrier respectively (Photo D). There also was an in-channel spurious signal 2.75 MHz above the video carrier at −53 dBc, and another 1 MHz above the audio carrier at −56 dBc. The worst case out-of-channel spurious was the transmitter's second harmonic, which was −29 dBc. The mixer LO signal was −35 dBc (372.75 MHz) at the

Why Vestigial Sideband?

A vestigial sideband (VSB) transmission is a signal type that falls somewhere between single sideband and double sideband, in which one sideband and a vestige (small part) of the other sideband are transmitted. This scheme was proposed in 1938 for commercial television broadcasting, so that a 4 MHz video bandwidth could be transmitted in a 6 MHz wide channel. Technically, the vestigial sideband of an over-the-air broadcast TV channel is what is left after filtering out most of the lower sidebands generated in normal double sideband amplitude modulation.

But why not just transmit TV pictures with plain old single sideband, if the goal is to use less RF spectrum? Unfortunately, the complex video signal transmitted by broadcasters is such that a type of picture impairment known as quadrature distortion results if at least some of the lower sideband does not accompany the full upper sideband. Fortunately, it was determined early in broadcasting that the sidebands more than about 0.75 MHz from the video carrier were small enough to allow removing some of the lower sidebands. This still results in another problem—group delay—but this is not nearly as bad as the quadrature distortion that would occur if true single sideband transmission were used.

The benefit of VSB to radio amateurs transmitting fast scan video is reduced bandwidth. In fact, a true VSB signal with a 4.5 MHz audio subcarrier will occupy only 6 MHz, the same as over-the-air broadcast TV. Double sideband could be as much as twice that! VSB benefits are quickly lost, though, if fast scan power amplifier stages are not extremely linear. The presence of the video carrier and its 4.5 MHz sound subcarrier in an amplifier circuit can generate third order intermodulation products, which appear as if new sidebands have been created in the amplifier. These "regenerated sidebands" actually are distortions that fall at twice the video carrier frequency minus the audio subcarrier frequency (2V − A), and twice the audio subcarrier frequency minus the video carrier frequency (2A − V). This is why broadcasters use separate video and audio transmitters, and passively combine the signals in a diplexer prior to the transmission line and antenna.

. . . de **N0IVN**

transmitter output. All other spurious signals were at least 50 dB down.

Another indication of in-channel frequency response is the demodulated multiburst test signal shown in Figure 2. The demodulated composite test signal in Figure 3 provides a visual indication of short time and line time video distortions, which are related to picture detail and sharpness. That test signal is also used to measure chrominance-to-luminance delay and gain, as well as differential phase and gain. This data is useful for determining how well color video will be transmitted. For a summary of that information, see the table.

How's The Image?

Though the transmitted pictures aren't broadcast quality, they do look quite good. In fact, under P5 conditions, and with identical video sources, you would be hard pressed to tell the difference between an ATV signal from the FSTV-430, and one from your local television broadcast station.

". . . under P5 conditions, and with identical video sources, you would be hard pressed to tell the difference between an ATV signal from the FSTV-430, and one from your local television broadcast station."

General Comments

The physical appearance, circuit layout, and mechanical design of the transceiver are very good. The ability to monitor transmitted and received video on a conventional television set tuned to the rig's IF (Channel 3 or 4) is a handy feature, and with its compact size (2.6" x 7.4" x 8.3"), it won't take up much room in the shack or out in the field. Power consumption is a bit on the high side for extended continuous operation with batteries, especially if a camera will be powered from the front panel 10-pin connector, but with an external supply, this shouldn't be a problem. The antenna connector is a BNC type; I prefer a type N connector for 70 cm operation.

The FSTV-430 manual is well-written and very complete. It includes a good block diagram and schematic, along with operating instructions and theory of operation. The only thing missing from the manual is information on alignment.

We had an opportunity to use the transceiver during the Denver area's weekly ATV activity night. Other hams receiving the FSTV-430's signal commented on its good audio quality, and judged its performance very good, too. The in-channel spurious signal 2.75 MHz above video did produce a very slight beat pattern in the picture, but it was not objectionable (this appeared after about a half hour of operation, and did not go away). We tested a prototype of the FSTV-430 a few months ago, and it did not have the in-band spurious problem. This is probably a bug unique to this particular transceiver. All in all, a nice rig! ■

FSTV-430 Video Performance

Line Time Distortion	1.1%
Pulse/Bar Ratio	118.1%
2T Pulse K-Factor	2.7% Kf
Chrominance-Luminance Delay	191.0 nanoseconds
Chrominance-Luminance Gain	148.5%
Differential Gain	15.5%
Differential Phase	9.5 degrees

Table 1.

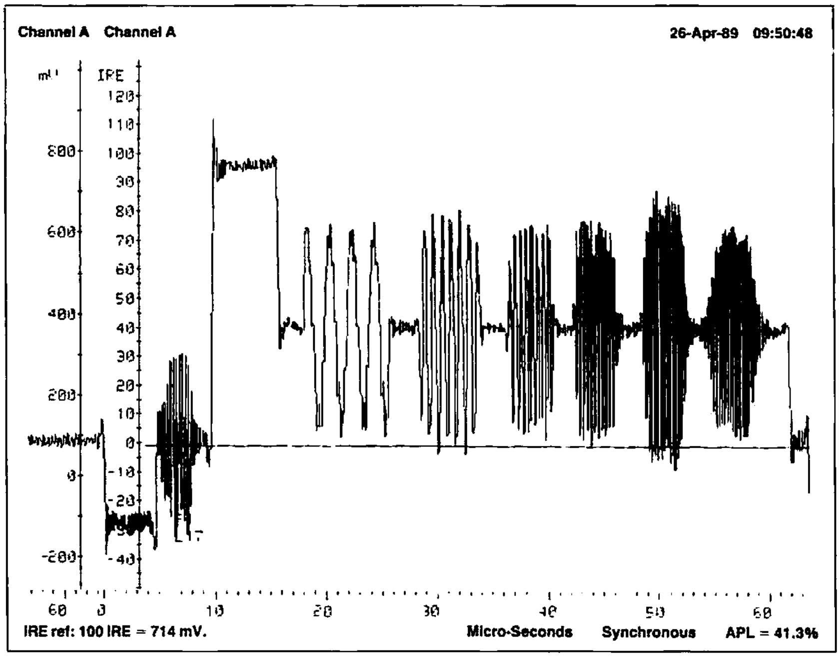


Figure 2. Demodulated multiburst test signal.

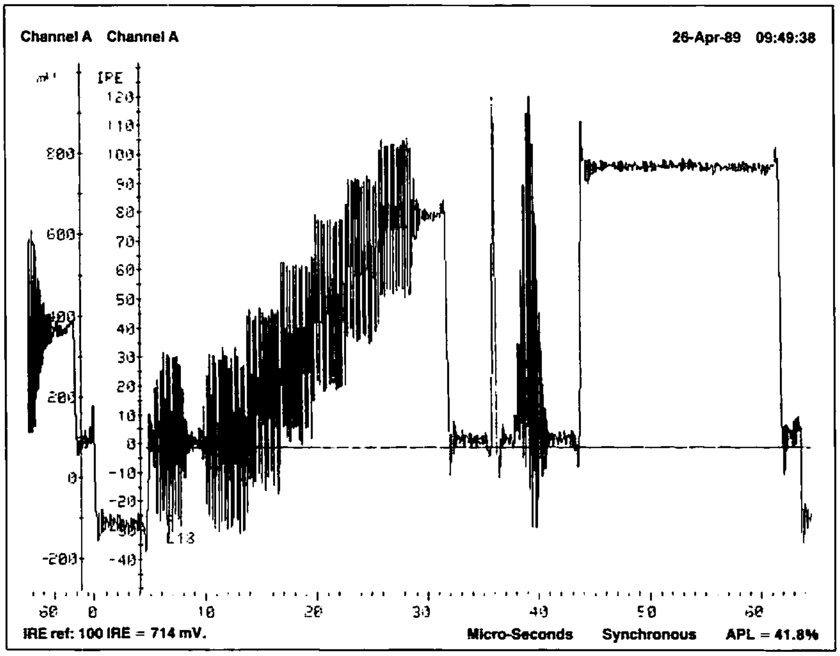


Figure 3. Demodulated composite test signal.

"'Black Bag'' Portable

Set up a portable QRP OSCAR station.

by Tom Hall N6DGK

There's been a lot of talk lately about working satellites with HTs, especially with the possibility of a Phase IV geosynchronous system in the future. Some amateurs have already experienced this by using one of the few gateway stations that operate through AO-10 and AO-13.

A gateway is basically a repeater linked to an OSCAR station, an exciting application of modern amateur technology, but not available to everyone. It is possible, though, to operate through LEO (low earth orbit) satellites with small low powered radios and simple vertical antennas. I've been doing this for some time using Mode A and operating through RS 11. The entire setup fits into a small black shoulder bag I call the "Black Bag Portable."

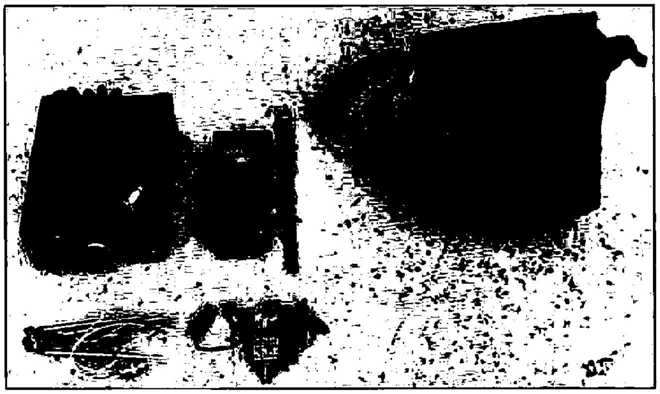


Photo A. Complete Mode-A station. It includes the FT-290 with telescoping antenna, the 10m DX handy, antenna stand with coax, and 10m GaAsFET preamp (with 9V battery and coax).

The heart of this system is AEA's new 10m Handy, and the older Yaesu FT290R, which is the radio recently used by cosmonauts U1MIR and U2MIR. The other parts of the setup are a 10m GaAsFET preamp and a telescoping groundplane mount for the 10m antenna. The FT290R is ready to go, using the internal telescoping antenna and 2 Watts. The 10m Handy, however, requires a search for crystals to put its two-channel VXO in the 29.5 MHz range. AEA does not have crystals for any frequencies above 29 MHz and does not guarantee performance above 28.6 MHz. The manual does infer that a factory retune is possible, but that pF course means that the low end performance would be lost. I decided to use the GaAsFET preamp to compensate for the lack of sensitivity in the satellite subband, hoping that the VXO would work at those frequencies.

Adding Crystals and Preamp

AEA provides 2 crystals, one which sets the range of the VXO from 28.250 to 28.30 and one for 28.30 to 28.350 MHz. I tackled the crystal problem with a call to Jan Crystals [P.O. Box 06017, Ft. Myers FL 33906, (813) 936-2397]. I've used them before as a source for "rock-bound" radios that I still have. Their service is good and the prices are reasonable. I asked them if they could make crystals for the frequencies I needed if I sent along one of the crystals I already had. They assured me it was no problem, so I sent one along with my order.

Photo B. Some Mode-A RS 11 operation from the Grand Canyon. The author just finished a contact with WA7NQQ in Oregon, TCA elevation was about 30° to the west. His report was S-5.

During the wait for the crystals, I ordered and built a GaAsFET preamp to make up for sensitivity lost at 29.5 MHz. This was a Hamtronics, Inc. [65 Moul Road, Hilton NY 14468-9535, (716) 392-9430] Model LNW-28. These preamp kits are a great value at only $24. They have other models that work all the way up to 500 MHz.

Also during the wait I ordered crystals from AEA to make the Handy work with the Hamtronics 435 downconverter in the mobile mode J station. That arrived ahead of the Jan crystals so, during the next mode JA pass of FO-12, I gave it a try.

The bottom end of FO-12's pass band is 435.8 MHz. The Hamtronics CA432-5, which is the one I am using, converts to 28.8 MHz. Since this is beyond the range of AEA's specs, I had some indication of what the performance would be like at 29.5 MHz. As it turned out, even with the Hamtronics 435 GaAsFET preamp I was using and the gain of the down converter itself, I could just barely make out FO-12's beacon. The DX Handy's volume control was all the way open. It definitely needed front end or IF gain, so I installed the LNW-28 preamp. The difference was dramatic! I now had more sound from the speaker than I needed and plenty of movement from the Handy's S-meter.

Operation at Home and on the Road

Finally the crystals arrived and I was ready for Mode A and RS 11. My first try was done

in the back yard using camera tripods for antenna mounts, the DX Handy's telescoping antenna, an AEA half-wave portable antenna for 2m, and of course the LNW-28 preamp. The entire setup worked better than I anticipated. RS 11's beacon was strong, tuning the passband was not too difficult, and my uplink was coming through loud and clear. I only made one contact on this occasion—KA0SHC in Kansas. His signal was S-9, very strong and easy to copy. He returned an S-5 signal report for the signal coming from the FT290R.

> ***"The heart of this system is AEA's new 10m Handy, and the older Yaesu FT290R."***

Since then I've used the portable many times in some rather unusual circumstances. I made contact with KA4BLN in Alabama while on a tour at Griffith Observatory in Hollywood CA, talked to WA7NQQ in Oregon from the south rim of the Grand Canyon, and worked WW6J from the Disneyland Hotel while attending Hamcon '88. I've also made two brief contacts with WB6LLO in San Diego through FO-12, with the addition of the CA435-2 downconverter and a small 432 yagi, still using just the FT290R and its telescoping vertical with 2 Watts of uplink power.

The "Black Bag Portable" is proof that amateur satellite ground stations need not be complicated or expensive. Operating portable does have its limitations, of course, but I've found a couple of tricks to make it work. Holding the FT290R in one hand while transmitting and rotating it in the air for strongest downlink keeps fading at a minimum. As the satellite passes, it slowing spins on its axis so rotating the 2 meter antenna keeps the polarity sense the same between satellite and ground. Mounting the 10 meter antenna at a 30 degree tilt from vertical and rotating it in a 360 degree circle has the same effect.

One precaution: I've also discovered that laying the 10 meter preamp along side the Handy can produce RF feedback and cause the receiver to go into oscillation. Always keep it at the top end of the radio!

For those who are interested in going portable, good luck. You're in for some real fun!

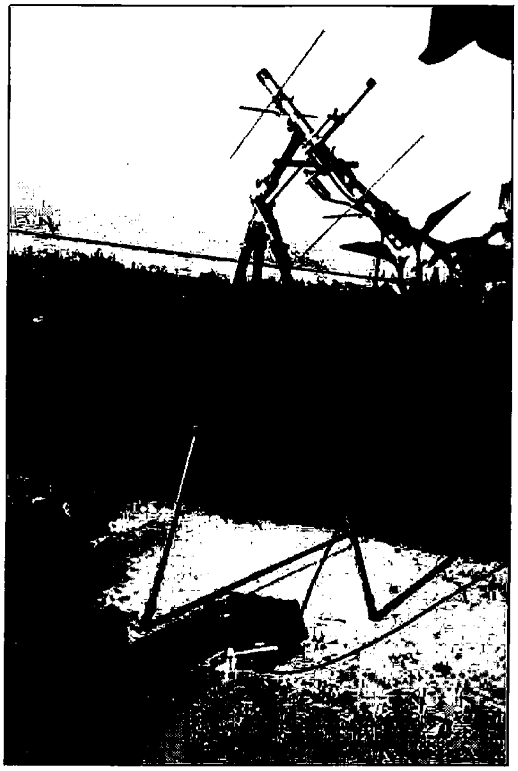


Photo C. A little FO-12 operation anyone? The author worked WB6LLO on Mode-J in two passes with three Watts on the 2m uplink.

Harmonic History

Thirty years of suspense. . .

by Elizabeth O'Connell

Thank goodness for television reruns. It took nearly 30 years, but I finally discovered how the Lone Ranger and Tonto escaped Miles Murdoch's deserted mine shaft. I was so excited, I immediately telephoned my sister.

"November 1955," I yelled. "Remember? The mine had just collapsed, Murdoch was rubbing his hands together with a sinister smile on his face, and Silver was reared up behind him, snorting."

"Yes, yes," my sister said, her own excitement mounting. "You found out what happened, didn't you? Don't make me wait," she demanded. "Tell me!"

Of course, I told her instantly. It had been the same anxious, suspenseful 30 years for her. After all, we had been harmonics together. Yes, harmonics. Most little girls are sisters, siblings, or daughters, but when your dad is a ham radio operator, you're a harmonic. Technically, in ham jargon, harmonic means an off-shoot of a principal signal that appears on a different frequency. Pretty clever.

Growing Up as a Harmonic

In the 1950s when Dad was on the air, we harmonics never saw nor heard a complete half hour of the Lone Ranger without the interference of Dad's mighty transmitter/receiver in the basement. The RFI went straight through the wall to the TV set in the living room, leaving our black and white heroes in static limbo. Those were the good old days before the refinement of amateur radio equipment, and eons before cable TV screened out all sorts of interference.

Now there's a carpet on the living room floor, which I suspect our mother put there to cover up a worn spot by the television where little fists pounded the floor and little girls hollered, "Dad, you're making interference!"

Subliminal Learning

The heat register in our bedroom, a great sound conductor, was located directly above Dad's radio. As my sister and I slept, mysterious codes floated up through the duct work, bearing subliminal messages.

CQ, CQ 40. This is W3TUG, W3 Tear-Uncle-George. Does anybody read me?

Translation: My dad, Mike, whose call letters are W3TUG, was on the air. Was anybody out there? Did anyone hear him and want to talk?

Through osmosis, we learned a great deal. We knew that Mom was his XYL—his married young lady. QSL cards were postcards hams sent to each other confirming their contact on the air. "Over" is what Dad said when he was finished talking and it was the other guy's turn. "73" meant good wishes, best regards.

Sometimes Dad let us say a few words into his microphone. We never said much, just harmonic gibberish. But once, Dotti spoke to a ham in England and asked him to send her a leaf from a tree in Robin Hood's Sherwood Forest. The gentleman was obliging, as we discovered most ham operators are, and mailed her the leaf. I imagine she was a big hit at Show and Tell, and I know she still has the leaf.

> ***"I believe he met his best company in 1970 when he became a member of the International Handicappers' Net."***

A Normal Part of Life

Ham radio was an integral part of our lives. I suppose it couldn't have been any other way. Dad has been involved with amateur radio since 1929. While in the Navy during the Second World War, he operated and maintained radio equipment. In fact, it was through his radio that he came to meet our mother. It was during the latter part of the war when he made contact with a young soldier over the air. Since both were on leave and lived near one another, Dad accepted an invitation to his home. Keeping in step with the high romance of the war years, the young soldier introduced him to his beautiful sister, Dorothy. She soon became W3TUG's XYL.

We've all moved on with our lives since then. My sister and her family are in Arizona, and my husband, son, and I live in Florida. Mom and Dad are still in Pennsylvania, but conditions are quite different now. Mom can relax in her recliner without worrying about interference from the basement.

Good Company

And Dad, although he doesn't jet around much, is far from stationary. Every day, his radio takes him all over the country and, indeed, the world. He's spoken to people in each of the European nations, including the Soviet Union. The air waves have taken him to the Kingdom of Nepal, South America, Christmas Island, Granada, and even the South Pole. His hobby keeps him in good company, such as Barry Goldwater K7UGA and King Hussein of Jordan JY1.

But I believe he met his best company in 1970 when he became a member of the International Handicappers' Net. Today he keeps busy as one of their board directors and daily net controllers. Every day but Sunday, Dad and the others meet on the air. Some 2,000 names compose their roster.

The International Handicappers' Net

They have a quarterly newsletter filled with great articles about members' accomplishments in the community, at work, and in organizations aiding the handicapped. The readers contribute solutions to operating problems, and sometimes an inspirational bit of poetry. Since most of the members are US Veterans, valuable reports on Social Security Disability Benefits are often included. One of the net chaplain's duties is to announce the deaths of members in the newsletter. These names are listed under "Silent Keys," a touching, symbolic way to say good-bye, a mnemonic for SK which in Morse code means "end of contact".

From the lofty scale of membership in the "President's Committee on Employment of the Handicapped," to the most personal level, helping is what Dad and his friends seem to be about. If a member is low on funds and can't afford to replace a vital piece of equipment, chances are his buddies in the net will pitch in and give him a financial hand. They're a caring group of people, and I'm proud my dad is one of them.

Only One Question

Yes, we've come a long way—my parents, my sister, and I, and of course, ham radio. But after all these years, after all I've learned, I still have one small question left.

It was 1957. Sky King and Penny were in the airplane, nose-diving a thousand miles an hour toward a rocky, treacherous mountain. Uncle Sky had just regained consciousness and reached for the controls when. . .

"With hearty 73s, this is W3TUG signing off!"

73 Review *by Terry Churchfield K3HKR*

Amiga AVT System

SSTV and FAX like you've never seen before!

Advanced Electronic Applications
PO Box C-2160
Lynnwood, WA 98036
Price Class: $300

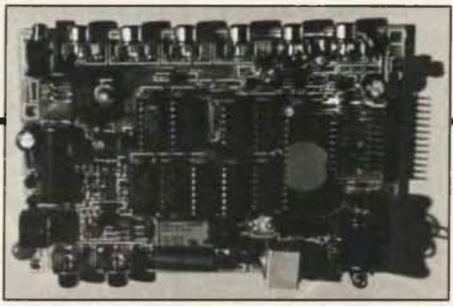


Photo A. The AVT Interface board.

Slow-scan TV (SSTV) has been a specialty in ham radio, practiced by a small group fascinated by the idea of sending video images worldwide on the HF bands. The practice of this mode, however, has been plagued by many problems—the expense of dedicated equipment, the susceptibility of the image to band noise and interference, and the lack of frame resolution, to name a few. The subject of this review, however—the Amiga AVT interface, conceived by Ben Blish N4EJI—uses digital techniques for dealing with slow-scan signals and images with astonishing *results . . . de NS1B*

A. Are you considering trying slow-scan television (SSTV)?
B. Would you like to receive FAX images for weather and news?
C. Do you think that SSTV is not worth the time, energy, or radio spectrum?
D. Are you looking into buying a new computer for business, home, and/or shack?
E. All of the above?
F. None of the above?

Even if you answered "F" to this simple multiple-choice questionnaire, you owe it to yourself to read on!

Life After 20m SSB

Hams with the least amount of curiosity can't help but want to experiment with exotic modes, such as FAX and SSTV. We soon hear, however, how expensive and time-consuming it can be to get involved with them. We couldn't afford, nor talk our wives into, buying equipment dedicated to SSTV or FAX.

Renewed hope came along with the growing availability of personal computer systems. This was something the whole family could use. Most PCs, however, are not designed for high quality graphic output. One recent newcomer is a dramatic exception . . .

The Amiga Computer

In 1985, Commodore Business Machines introduced a new computer using a microprocessor capable of true 16-bit addressing. This computer had the most advanced graphic co-processors of the time and true multitasking capability. Multitasking is the capability of a computer to run two or more programs concurrently. (Programs "time-share" the CPU in tightly-timed cycles.) This was a breakthrough for personal computers.

The Amiga is capable of running MS-DOS programs, so I could upgrade to the Amiga and still use my PC software. With a few inexpensive add-ons, I can run C-64 or Macintosh software. Because of multitasking, I could, for example, operate packet on the PC side and use my word processor on the Amiga side at the same time. The packet information can be saved as an MS-DOS file that I could use in my documents on the Amiga.

The Amiga's true NTSC composite video allowed animation, character generation, and high quality image art output to my VCR. I taped weddings, hamfests, and company picnics, and added graphics and titles to my home VCR movies. This $1600 investment —which comprised an Amiga A2000 micro-

Photo B. The AVT control panel, on lower half of photo.

Photo C. The AVT control panel with I/O window open. The six icons on the screen are coupled to the six input jacks on the AVT interface board.

computer with a floppy drive and 1 megabyte of memory, color monitor, and mouse—really turned out to be useful for the entire family!

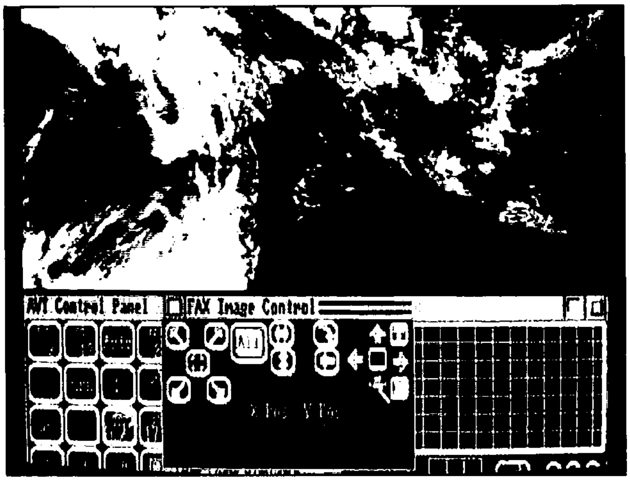


Photo D. Shot of the FAX screen supported by Tim N4IFP's PCB. It supports the images in 16 gray levels. (Most FAX is black and white.)

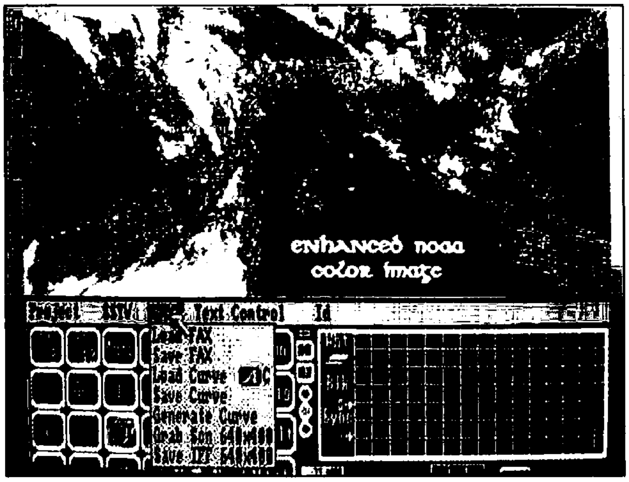


Photo E. Same FAX image as in Photo D, after having gone through PixMate image processing.

A Look at SSTV

Using the Amiga for SSTV had real promise, since I had a nice HF setup. I could get involved with my computer graphics and my radio at the same time, without adding another large expense to the already well-working station. There was still, however, a missing link—an interface that would take video signal data from a receiver and give it to the Amiga in a form it could deal with.

Enter The AVT Interface

The answer came in late 1988, when a group of software and hardware developers, headed by Ben Blish N4EJI, created the Black Belt System "AVT." The hardware is a 3-inch by 5-inch printed circuit board that interfaces between the audio section of the receiver and the parallel port on the Amiga. The software is on a 3.5 inch (880 KB) floppy diskette. The user furnishes a 12 VDC power source, a connection to receiver audio, and an interconnecting cable from the Amiga's digital sound port to the transmitter input. The AVT software requires an Amiga with a megabyte of random access memory (RAM). A color monitor is suggested, but not required.

The Amiga is very user-friendly. I was impressed at how easy it was for me to get the system up and running. The Black Belt System software takes full advantage of the graphic, icon-based user interface. That is, a menu that uses graphics to show choices appears on-screen, and you can move around this menu and make choices with a pointer moved by a small table-top controller called a "mouse."

AVT vs. Conventional SSTV Modes

The major advantages of the AVT modes over conventional SSTV modes are:

- Images always maintain color accuracy.
- Images always maintain horizontal and vertical position.
- Images always start at the top of the display.
- More efficient use of the radio spectrum.
- The narrow bandwidth allows use of filters and blanker.
- More effective use of the transmitting equipment.
- High and super-high resolutions with black and white/color/3D capability.
- Fully automatic operation.
- Full support to the ARexx interface language.

The first thing I noticed when I got the system up and running was the AVT buttons for 24-second, 90-second, 94-second and 400-pixel modes. The 24-second and 90-second video modes are much like the Robot versions in 24- and 72-second format. In fact, these modes directly support each other almost pixel-for-pixel. AVT modes have a very important difference, however, from the Robot versions—they do not require a transmitted sync pulse.

How is this possible? In conventional modes, these pulses are critical. A missed vertical pulse sends the line back to start, and a missed horizontal pulse causes all sorts of odd things on the received image display.

In an AVT mode, the sync information is sent in a "header"—a block of information sent ahead of the image. The AVT knows what mode and what speed is being sent prior to image information. After the software calculates this information, the system simply sets the "start" position to the top of the screen and begins its scan down the screen. You can even tune to another frequency while receiving an image, and then return to the original, only to have the AVT pick up with the proper scan line at the right position on the image. (A new version of the Black Belt System will contain an image fill-in feature, based on examining the existing image lines!)

The main advantage of the "syncless" system is reduced signal bandwidth. AVT signals are approximately 400 Hz wide—a reduction over the narrowest conventional SSTV signal bandwidth of over three times. You can use your 500 Hz CW filter to isolate it!

Having a narrower bandwidth presents several advantages. With the reduced signal bandwidth comes an increased Signal-to-Noise (S/N) ratio—in this case, about 3–4 dB better than that in conventional SSTV modes. The line noise I heard on some dry weather condition days did not affect the image as much as I'm used to. Another result of narrow bandwidth is the reduction of mutual QRM with neighboring stations. Finally, it more tightly channels the available transmitter energy. I got the same results with the output backed off from the position I had it at when transmitting conventional SSTV.

There are many SSTV modes, with 15–20 of them in popular use. Some of the most popular frequencies include 3.845, 14.230, and 28.680 MHz. There is an Amiga SSTV net operating at 14.233 each Saturday at 02:00 UTC (21:00 EST Friday). Because mode configuration had been hardware dependent, adding new modes to a system could be quite expensive and complicated. Much of the mode configuration in the AVT system, however, is software based, making additions and updates much easier and cheaper.

The current software allows transmit and receive of all the common modes used today. Black Belt Systems updates the software as needed to support new modes as they are developed (such as the Scotty and Martin modes).

Robot Modes

These are the most common SSTV modes. Exchanging images with Robot users via the AVT system is easy. These formats include all monochrome and color. The AVT unit supports both the original US version (60 Hz line frequency, 8.5-second black and white, 128 pixel horizontal by 128 vertical) and the European version (50 Hz, 7.08-second black and white). The Robot 400C, 450C, and 1200C modes are, respectively, 8-second black and white, 12-second black and white, and 24- and 36-second black and white.

The AVT system can both receive and transmit Robot color modes. Included in these modes are 12-second, 24-second, 36-second, and 72-second composite color. All new Robot modes encode the memory (R, G, B or

composite), resolution, and speed of transmission. The AVT system detects this signal and responds accordingly.

Other Popular Modes

Another popular mode is the **WA7WOD Modification** of the Robot 400C, in formats of 17-second black and white, and 25.5-second, 51.0-second, and 102.0-second line-sequential color. The color resolutions up to 256 by 256 pixel are displayed in 4096 colors on the Amiga.

The AVT system supports the **Microcraft Videoscan** modes. These include 17- and 34-second black and white. Resolution is 256 by 256 pixel in monochrome display.

The **Volker-Wrasse** line-sequential system has red sync-locked color modes in 24-second, 48-, and 94- second color formats. Resolution in this format includes 256 by 256 pixel in 4096 colors.

This system even supports the black and white **Visitel** mode (see article in Jan. 1989 73).

When receiving or transmitting any of these modes, the Amiga and AVT system work in 64 gray levels receive/transmit for monochrome, and 64 luma/chroma levels in color. The detail of such images is preserved because the AVT system saves all images in digital format—which maintains image integrity far above that of analog tape storage units.

High-Res Images

The 94 AVT format, the most popular AVT mode, is a 320 by 200 pixel screen in 4096 colors. This mode requires 94 seconds to transmit.

Next up in image quality is the 320 by 400 pixel screen in 4096 colors. This is an interlaced screen and is perfect for direct output to a VCR. This screen requires 184 seconds to transmit. The exciting thing about this mode is the true 3D images that can be produced on the Amiga and transmitted via SSTV. You view the image through a pair of 3D glasses.

The high resolution screen is a whopping 640 by 400 pixels. This screen is sent in only 125 seconds, because it is available only in 16 levels of gray (black and white). At this resolution sending text, PCB layouts, detailed pictures and much more, can be fun and very rewarding. This resolution places the AVT system in a commercial class with some small FAX systems.

All the images sent in AVT modes can be converted into an Amiga file storage format known as IFF (interchange file format). This format allows any picture received to be used with any Amiga graphic program. High resolution images can be converted and later used in desktop publishing programs. Pictures received on the Amiga can be converted into PC images for use on clones or a compatible.

Special Features

I found the higher resolution AVT images of commercial quality, and indeed make SSTV well worth a second and third look. I am building up a library of "slides"—I can fit several such 320 by 200 slides on a single 3.5-inch diskette.

The AVT system is replete with graphics bells and whistles. A simple Draw function allows highlighting, touch-up, and features addition. There is a zoom mode that allows picking up a portion of a picture and transmitting that portion.

The drawing function is rivaled by many Paint programs that can run as a background task in conjunction with the AVT system. One such program is Photon Paint (MicroIllusions Software, Photon Paint, 17408 Chatsworth Street, Granada Hills, CA 91344, Tel: 800-522-2041). This program directly supports the low and medium modes of the AVT, and does its thing in all 4096 colors.

The **Cleanup** function allows you to use minor image process techniques on poorly received images. Images degraded by multipath, static, etc. are partially recoverable. This process looks at individual neighboring pixels, then decides if the pixel belongs or not. If it does not, then it is simply replaced by the average surround. The AVT system uses a geometric process algorithm by which the image processing is selective from the AVT control panel. This is an added feature not available on other systems.

The Text Entry function lets you add text to any picture. The Amiga allows a great number of fonts. The pop-up windows open to reveal a text input screen. Just choose a font style, then preview your text input before you add it to the picture. Here again, the program supports all 4096 colors.

The Amiga supports up to 8 megabytes of memory. At this level you could have several memories waiting for pictures received and prepared to send. I found I could easily review the various memories' contents.

The Speech and CW Tone ID functions are fun and useful. You can set any text length up to 80 characters. CW transmission is clean and can be made to directly key the transmitter. The voice function has several settings for speed, pitch, and inflection, plus a male voice for the OM and a female voice for the YL. And, the Amiga understands true words—you don't have to type in phonemes.

There is a function that lets you output to a telephone line. That's correct. . .SSTV over the land line! Even if you are not involved with amateur radio, you could use this system to transmit pictures of the family, new baby, or new house over the telephone to friends thousands of miles away in only seconds, in full color. The telephone output is in full duplex.

The I/O routing routines give the operator the ability to route 5 inputs to the output. There are two output connectors, and an RJ-11 phone connector. There is a touch tone pad in this function window.

Since SSTV can be sent over 2m FM repeaters, the touch tone functions could be used to control the repeater for these SSTV modes. For example, you could hold the repeater ID and let the AVT system send it after the picture. It's very easy to route the input signal to the outputs, or vice-versa.

The Set function lets you decide how to send the image. In heavy QRM you can choose to turn on notch filters. A narrow transmission mode supports this mode. The bandwidth is cut well below the normal 1.5 kHz (about 400 Hz), so you can use notch filters to cut out QRM and some types of energy QRN. The operator can use 50 or 60 Hz output for NTSC or PAL systems. Some of these functions are available only for the AVT modes.

One underlying feature is the ARexx Language option. You can use the ARexx interface with any of the functions. This powerful, high-level script language allows support of macros, scripts, and inter-process communications. The ARexx option is a good way to control the Amiga's multitasking features.

Creating pictures is a lot of fun! I use the "FrameGrabber," by Progressive Peripherals (Progressive Peripherals and Software, FrameGrabber, PixMate Software, 464 Kalamath Street, Denver, CO 80204, Tel: 303-825-

OverView Mini-Review

While I was on the air one night discussing the AVT system, Tim Heffield N4IFP introduced me to a FAX board he just developed. OverView APT allows everything from recording NOAA satellite passes on stereo tape decks, to saving the image (digitally) on the Amiga via the AVT system. The features include:

- Use of low cost recording equipment via a recording technique.
- Phase-locked sync.
- Auto detect of passing satellites.
- Autostart and stop of recording units.
- Tape deck control for use with all Black Belt System modes.
- Control of recording unit and receiver, totally independent of the computer.
- Full multitask support through the AVT system software. (e.g. sending an SSTV image while receiving a NOAA FAX image.)
- A panel-mounted level control for contrast.
- Panel-mounted LEDs for sub-carrier and sync detection.

I was delighted to see how easily this patched to the AVT board. Simply mount the board, connect it using RCA jacks and a sync header pin connector, and add 12 VDC and you are ready to go. A few mouse clicks and you are viewing NOAA satellite passes on the AVT system screen. You can view images in two ways: in real time, or after they have been recorded. There are several commercial applications available for it, including small weather tracking systems for radio and television stations.

Overall, the OverView ATP documentation is very good. It contains numerous hints and details for optimizing image reception. I built, and used, the antenna as described in the manual for a cost of about $20.

4144). This optional interface allows me to input images from my commercial TV, VCR, or Camera. The image is grabbed in real time at 1/30th of a second. The frame grabs are in vivid color and support all resolutions. The AVT has a grab-screen routine that will allow any IFF picture image to be converted to SSTV format for transmission in any mode. You can use the image process software "PixMate," also by Progressive, to further enhance these images prior to broadcast.

FAX

FAX is the latest rage in commercial communications—it allows you to send copies of images over the phone lines. Commercial FAX, however, doesn't support gray scale. Because of this, most FAX systems do not handle halftones very well. Images that print directly to low resolution printers have no value at all. If the 1000 by 1200 pixel FAX image was sent to a printer in 1:1 resolution, the printout would be about 3 inches by 4 inches. That would require a laser printer at 300 DPI output. There is no dot matrix printer on the market that can do true halftones!

in SSTV modes at the 125-second rate. The image is displayed in 16 levels of gray, and may be color-enhanced using any good image process software such as PixMate, mentioned earlier. You can save the FAX images in IFF for conversion into other programs, including direct conversion into PostScript format for laser printers. See the sidebar for a mini review of a particularly effective FAX interface developed for the AVT system.

Getting A Print-Out

You can extract hard copy of the image in several ways. The Amiga presently supports over 200 different printers. The Postscript conversion for up to 2450 DPI resolution is another good way. You could use a thermal video printer. The Amiga supports composite monochrome output for just such a purpose.

Receivers for these satellites are not commonplace. Tim Heffield N4IFP recommends either the Vanguard Labs FMR-260-PL, or the Hamtronics Model R137. These are crystal-controlled units. Insert a good FM preamp at the base of the antenna.

You never know, however, what you may come across at a hamfest. At the '89 Dayton hamfest, a fellow foisted his Lafayette HF 60 rig off on me for $10. This rig receives three different HF and VHF bands, including the 137 MHz NOAA satellite band. With minor tweaking, I started pulling down NOAA signals—without even using an RF preamp!

> ***"The Cleanup function allows you to use minor image process techniques on poorly received images."***

I was curious to see how well the FAX modes worked, and a trip to 8.078 MHz was very rewarding. I was pleased to see that the AVT FAX supports up to 16 gray scales. The system worked exceptionally well.

I chose my desired FAX resolution (60 or 120 lines per minute) and the FAX window opened up to reveal some additional functions not available in the SSTV mode. The Amiga allocates a lot of memory for the system (650 KBytes), since FAX images are so information-intensive. The WEFAX images are received in a 1024 by 1200 pixel resolution. The 120 LPM images take 10 minutes to capture, while the 60 LPM image will take 20 minutes.

AVT supports FAX autostart. The AVT looks for a 300 Hz tone being transmitted. If this tone is detected, the AVT proceeds to the phasing state. The AVT then continues to monitor for a ½ scan all-black condition, at the selected line rate. Once detection occurs, the AVT system then locks the time interval to the beginning of a scan line, and reception begins. Fear not! You can override the autostart system even if you missed the sequence completely. In fact, you can enter a FAX receive mode at any time during transmission.

The HF FAX images are sent in black and white. There is full support for 64 levels of gray, in both transmit and receive. The full FAX image can be displayed in a scrolling 600 by 400 window.

The AVT FAX panel contains several gadgets that allow image correction: top to bottom, and side to side. Scroll through and direct the X and Y coordinates. You can size down the 1024 by 1200 image to a 640 by 400 image, then send the smaller resolution picture

Conclusions

The one drawback to the Black Belt AVT System is the computer-generated noise. Because of computer CPU speeds the AVT system becomes a transmitter of noise that can get into a receiver system. With later versions of the hardware and some corrective lead dressing, this problem can be eliminated. I traced a large receiver leak to my RF wattmeter. Simple shielding was the corrective measure.

The AVT documentation leaves a bit to be desired. The user must understand the Amiga to some degree above novice. There is no manual as one might require. You will have to have a printer to get hard copy from the disk.

AEA, however, who will soon be marketing the AVT unit, is producing hard-copy documentation that the beginner can understand.

The Black Belt System is the very latest technology for image reception using audio frequencies. The developers involved with this new technology have broken ground for visual communications via radio, satellite, and telephone. This system lets you transmit over large spans of distance and time, at a cost well within a reasonable budget. The uses of such transmission for business and pleasure are endless.

See you on slow-scan!

Number 10 on your Feedback card

73 Review *by Phil Nowak KA9KAF*

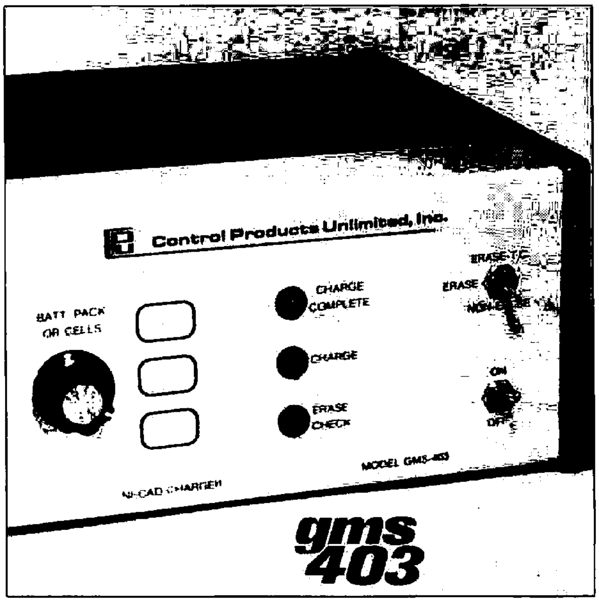
Control Products Unlimited, Inc.
5 Somerset Drive
Coatsville, PA 19320
(215) 383-6395
Price Class: $270

GMS-403 NiCd Charger

Erases charge level "memory" and charges almost any NiCd.

I remember one of Wayne Green's speeches in which he said something like, "One of these days someone will build a charger that cycles NiCds properly. I expect him to make a lot of money with this product." This comment hit home with me one Wednesday in April, two days before the '88 Dayton Hamvention. It was time to locate and charge all the NiCd batteries for the two handie-talkies the YL, Alida KA9KAG, and I were taking along. I don't use my handie-talkies much during the year, so the batteries had been Idle for quite some time.

I plugged some batteries into the wall chargers, and changed batteries in the quick charger each time I woke up during the night. On Thursday morning I checked the results. One battery had failed to charge at all. The rest were in some state of charge. They worked the radio, but how long would they last? The YL and I had carried lots of questionable spares before. It wouldn't be the first time she and I had lost communications, and each other, in the giant Hara Arena. It was with this uncertainty that we left for Dayton.



The NiCd Charger

On Friday afternoon, I stood in front of the booth of CPU, Control Products Unlimited. Their model GMS-403 charger appeared to be the answer to my NiCd failure fears. Joe Fell WA3GMS, the company president, described the features of this charger. I was fascinated.

The charger has three switches and three LEDs on the front panel. There is an ON/OFF switch, a three position rotary module select switch, and a three position mode select toggle switch.

The mode switch determines what you do to the battery. You can choose NON-ERASE, ERASE, or ERASE-T-C. The module select switch tells the charger what kind of battery you have connected. Its LEDs are labeled ERASE CHECK, CHARGE, and CHARGE COMPLETE.

Discharging and Charging

The most commonly used position of the mode switch is ERASE. In this mode, the unit discharges the battery or pack connected to it before recharging, erasing any memory. The red ERASE CHECK LED will light up while the battery is discharging. Once the voltage drops to 0.9 volts per cell, the ERASE CHECK turns off and the charge cycle begins.

The charge procedure is different than the ordinary quick charger or wall charger. A charge cycle is 1000 milliseconds, or one second. The unit hits the battery with a four ampere jolt for the first 100 milliseconds. This is to rid the battery of any "whiskering" leading to inter-cell shorting. The CHARGE LED flashes on while charge current is flowing. Nothing happens for the next 600 milliseconds. Then the unit places a 500 mA load on the battery for 16 milliseconds, and measures the battery voltage under load. The ERASE CHECK LED blinks on during this time. Nothing happens for the next 284 milliseconds, and this completes one charge cycle.

"The unit hits the battery with a four ampere jolt. . . to rid the battery of any 'whiskering' which could lead to inter-cell shorting."

The unit continues the charge cycles until the voltage reaches a nominal 1.36 volts per cell. When this happens, the CHARGE COMPLETE LED glows green. If the voltage never gets to 1.36 volts per cell, the unit times out after a predetermined time. In this situation, the CHARGE COMPLETE LED will glow red. In either case, the battery has received all the charge it's going to get.

The NON-ERASE mode works as stated above, except that it skips the discharge step.

Use the ERASE-T-C (time charge) position for older batteries, or to condition new batteries. This mode works like the ERASE mode, except that it lets the battery time out.

This charger is designed to be connected directly across the electrical output terminals of the battery. Wall chargers generally feed AC to the charge jack on the battery back. An internal diode converts this to pulsating DC. The high charge current of the GMS-403 will destroy this diode if you hook it up to the charge jack instead of to the output terminals.

Choosing and Using a Module

How does the unit know what kind of battery you have? You tell the factory and they include a program module for your battery. They need to know the number of cells and the battery Ah rating. Each different battery configuration needs a different module. A module of your choice comes with the charger. Extra modules are $5.00 each. I ordered two

additional modules: one for a nine-cell ICOM BP-5, rated at 450 mAh, and one for an ICOM BP-7 containing seven cells, rated at 800 mAh.

Up to three of these modules plug into the base of the unit. The three-position rotary module select switch on the front of the unit selects the module to be used. It is possible to order an extra side plate with a twelve-position rotary switch and additional module holders, allowing you to use up to fourteen modules. One module slot is used to plug in the module extension board. This extra is available for an additional $89.

The Acid Test

I was pre-sold, but I did hesitate at the price. Even with the usual Dayton discount, it seemed a lot to pay just to charge the batteries. That's what I thought on that Friday.

I couldn't wait to try it out Friday night back at the motel. I fed all of my batteries, both good and bad, to the charger. At this point the first weakness showed up. The original version of the documentation was a poor copy, and poorly written. CPU had spent good money on a nice double-sided promo sheet, but stopped when it came to the instruction sheet. (Note to developers of hardware and software: Either hire a professional with good technical writing skills, or ask people who are unfamiliar with your product if they can figure it out from the instructions.) I couldn't tell if the unit was set up properly. Some of the batteries didn't seem to charge long enough before the green light came on. I got very strange results when I went to charge the BP-5. Oops, my fault, I had selected the BP-3 battery module. I understand CPU is working on a better instruction sheet.

Saturday was the acid test. For some reason the batteries didn't seem to last very long. Fortunately, there were enough spares. Saturday evening all the batteries went back to the charger.

Sunday noon I went back to see Joe Fell at the CPU booth. On the insistence of my YL, I took the charger along also. It turned out that the voltages were set about a volt too low for each of the batteries. There is a procedure in the instructions to remedy this situation, but it wasn't that clear to me because I didn't understand the documentation. Joe was very cooperative in adjusting the unit.

A word about the connectors: They plug into the unit with banana jacks, which is fine. The battery end, however, is a little L-shaped hook. This works okay on older ICOM batteries, but not the newer ones. You have to design and build your own battery connector.

Ultimately Inexpensive

The weekend provided a nice shakedown of the unit. Despite the minor voltage adjustment, inadequate instruction sheet, and awkward connectors, I really liked the unit. It will charge ANY NiCd from one to twelve cells—it's definitely not limited to ham radio applications. It is also not limited to any one brand of battery. You can use this unit to charge NiCd batteries for flashlights, video cameras, smoke detectors, toys, laptop computers, portable stereos and tape recorders, to name a few items.

This is where I started to rethink the cost. How often do you buy a new hand-held radio and have to start all over again with another expensive quick charger? When ICOM introduced the BP-8 battery, my old quick charger wouldn't charge it. That's why I never bought a BP-8. Commercial users have the same problem if they change vendors of two-way radio service. When you add up the cost of buying new quick chargers every time you change radios, it doesn't take long to get to the price of the CPU GMS-403, even without a Dayton discount. When you consider that this unit is a universal charger, the cost appears quite reasonable.

Another nice feature is a by-product of the charge cycle. The battery doesn't heat up or overcharge. This advantage, combined with the memory erase feature, should make your batteries last longer than you would expect. Have you priced new NiCds lately?

I no longer worry about my NiCds. They just sit quietly on the shelf until they're needed. If there's any doubt about their condition, a half hour or so in the GMS-403 and they're ready to use, good as new. This is an excellent unit, and one of the few that properly conditions and maintains NiCd batteries. 73

Four In/Five Out

Independently adjustable mixed audio outputs.

by John R. Flint KAØLDB

You're driving down the highway, an hour from home. It's late, and no one is on the local repeater. A front is moving in from the west, and it looks bad. You pick up the mike, hit a few buttons, and instantly you're linked to another repeater a hundred miles to the west. Someone can fill you in on what to expect in a few hours.

Remote bases are not new, but an easy way to adjust, mix, and distribute audio hasn't been covered in the literature. In the above system, audio from both the UHF repeater receiver and the 220 remote base receiver are fed through a switching circuit and into the mixer. The outputs of the mixer are connected to the UHF repeater transmitter, the 220 remote base transmitter, and to the control decoder. See Figure 1.

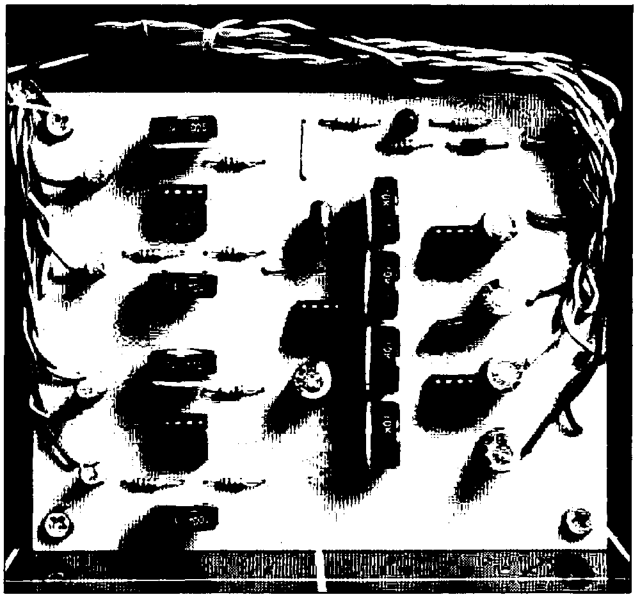


Photo A. Four In/Five Out audio mixer board.

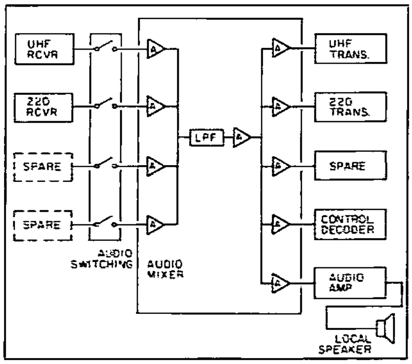


Figure 1. Block diagram of the Four In/Five Out audio mixer.

The Problem

I first worked a repeater at the University of Missouri with the Rolla Amateur Radio Club (WØEEE). Funds were limited, but we had a repeater on the air in four months. We'd worked out most of the bugs, except for two that were particularly aggravating: muffled transmitter audio (the main problem) and an inability to mix additional audio signals not originally planned for. Several local hams were building repeaters and had similar problems.

The Answer

Mahlon Haunschild N4PSD and I researched the available articles for a solution. The common circuit at the time was a potentiometer network feeding into a single transistor amplifier. The drawback of this configuration was that the input impedance, and therefore the audio level, changes on *all* inputs, when any input is adjusted. We sought a better solution.

The solution turned out to be a simple two input/one output op amp mixer which Mahlon had built during a school holiday. It performed as expected, and it's still operating more than five years later.

I built two more audio mixers, a four input/two output, and an eight input/four output. To build each of these took about six hours. I had invested enough time into hand-wiring these mixers, and I decided to make a printed circuit board (see Figure 2—foil diagram).

Circuit Workings

The final configuration of the mixer was four inputs and five outputs. An op amp for each stage may seem extravagant, but it allows both individual gain select and input isolation. Several of these mixers are in service and working well.

Five basic parts comprise the mixer (see Figure 3). The power portion of the mixer consists of a series-connected diode (D2) which protects against reverse polarity. The LED (D1) is an ON indicator, which can be deleted for reduced power consumption. The two resistors, R9 and R10, bias the op amp for operation from a single-ended, 10 to 15 volt power supply. The bias voltage is VDC/2.

A capacitor (C11), located at the output stages, is used for power supply bypassing. Each input stage consists of a DC isolation capacitor and an inverting amplifier. The gain from each stage is set by the ratio of the variable resistor to the input resistor (for example, gain=VR2/R2=100k/10k=10). To adjust the maximum gain of each stage, substitute a different value trimpot for the one shown.

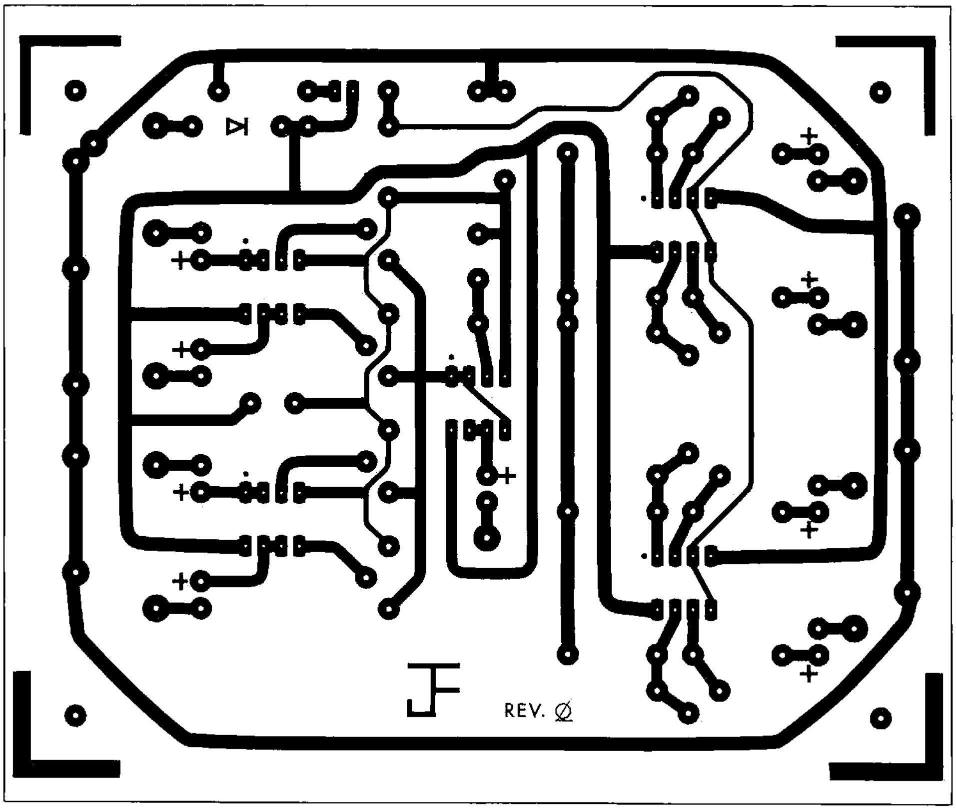
The output from each input stage is mixed through a 10k resistor. This arrangement results in a voltage divider which is equivalent to a 10k resistor series connected to a 3.33k resistor (three 10k resistors in parallel). Inputs are attenuated to a quarter of the gain calculated above.

The 0.01 microfarad capacitor (C5) with the three 10k resistors in parallel, form a low-pass filter to cut off frequencies above 6 kHz (see Figure 4). The mixed audio is routed to an op amp (U3A) wired as a unity gain buffer. The low-pass filter sees a very high impedance load so the cut-off frequency isn't affected.

The buffer also provides the level required to drive the output stages. One of the output stages (U3B) is not adjustable. You can use it to drive a local audio amplifier or any load with an internal gain control. The four other outputs are similar, except that they have level adjustments.

A note on the layout of the PC board:

Figure 2. PCB foil diagram of audio mixer.



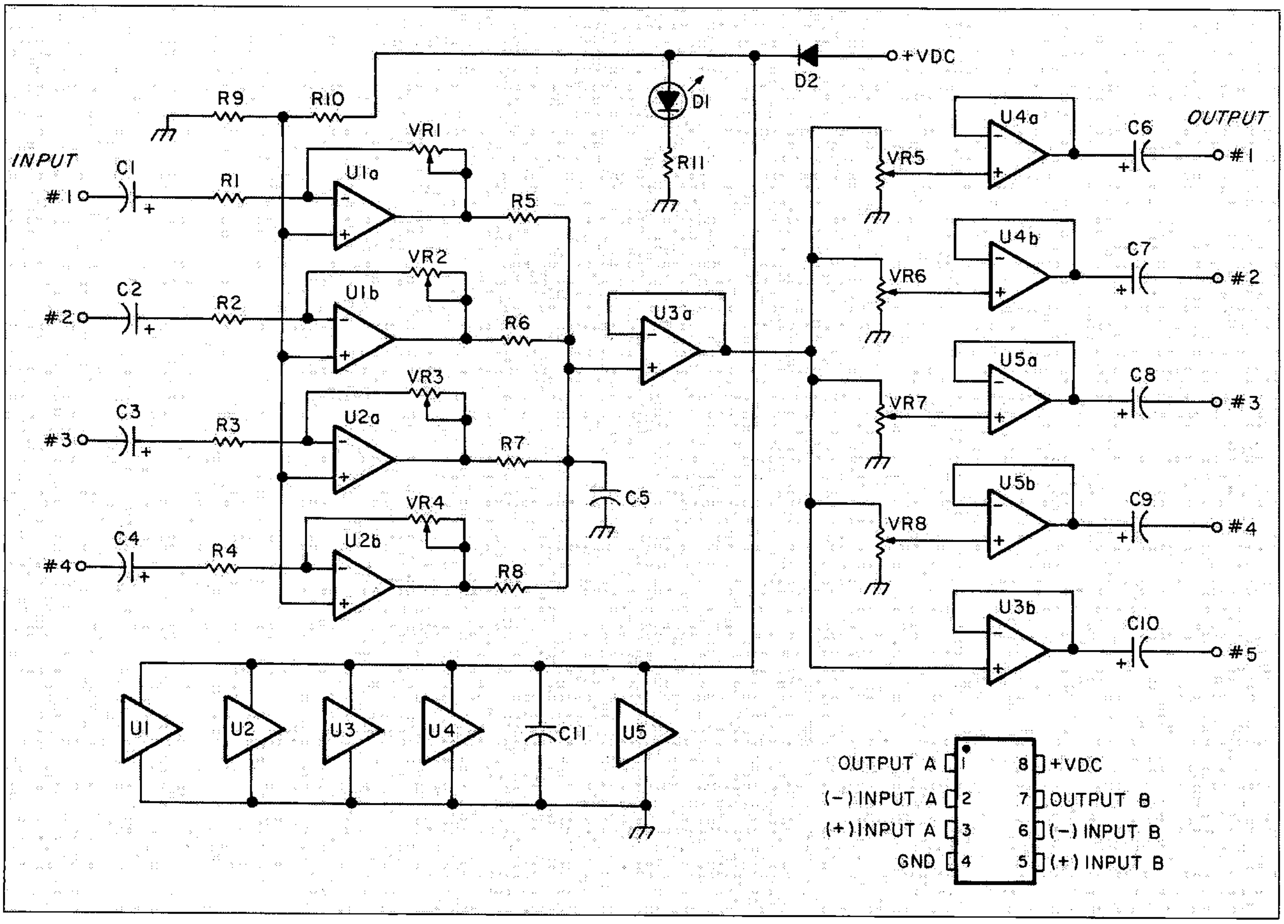


Figure 3. Audio mixer schematic.

Special attention has been given to the ground bus. The signal line grounds are run together to the upper right corner of the board (as viewed from the component side—see Figure 6). The power grounds from the op amps are run together and terminate at the same corner. There are two connections at this point. One is for the power ground which is run with the +VDC wire. The second is for the connection to the enclosure. This should be the only connection to the chassis, thereby eliminating ground loops within the audio circuits.

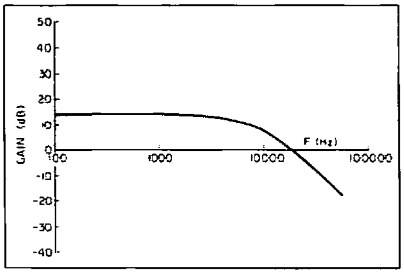


Figure 4. Gain/frequency graph of low-pass filter. The cut-off frequency is defined as 3 dB below the nominal. The nominal gain here is 12 dB, so the cut-off is 9 dB, which occurs around 6 kHz.

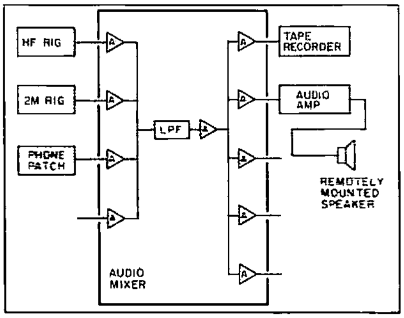


Figure 5. Suggested hook-up for the Four In/Five Out mixer. You can monitor both rigs from the same remote speaker.

What Can Yon Do with It?

Applications are not limited to repeaters. In the shack, multiple sources are often combined. You can replace the board-mounted trimpots with panel mount pots, for easy adjustment. If the wire lengths exceed a couple of inches, be sure to use shielded wire. If you are driving the mixer from a speaker output, provide a suitable load for the source. Let me know if you come up with any unusual applications.

One example is to connect the outputs of an HF rig, 2 meter rig, and a phone patch, to the inputs of the mixer. You can then use an output to connect a tape recorder. You can adjust the inputs for proper levels, and record any of the input sources without constantly changing patch cords and adjusting levels. You can use another output with a small audio amp for a remote speaker. This allows you to monitor both rigs on one speaker (see Figure 5).

Construction of the Mixer

The mixer, built from readily available parts, is designed for ease of servicing. You can obtain parts mail order or from Radio Shack. Construction isn't critical; perf board is fine.

I like to keep the inputs on one side of the board, and the outputs on the other (see Figure 6). This makes troubleshooting much easier. If space is at a premium, you can make the mixer smaller by using miniature components. The printed circuit board for this project, with schematic and component layout, is available for $15, including shipping. I hope this project will solve some of your audio problems. ■

Parts and Price List

Part	Description	Jameco (except as noted)
R1–R10	10k 5% 0.25W	$ 0.06 ea.
R11	1.2k 5% 0.25W	0.06 ea.
VR1–VR8	100k vertical trimpot	0.59. (Radio Shack)
C1–C4	4.7 µF 25V DC	0.12 ea.
C5, C11	0.01 µF 50V DC	0.06 ea.
C6–C10	47 µF 25V DC	0.15 ea.
U1–U5	MC1458 dual op amp	0.39 ea.
D1	0.200" LED	0.12 ea.
D2	1N4003 1 Amp diode	0.11 ea.

Total parts price listed above: $8.91

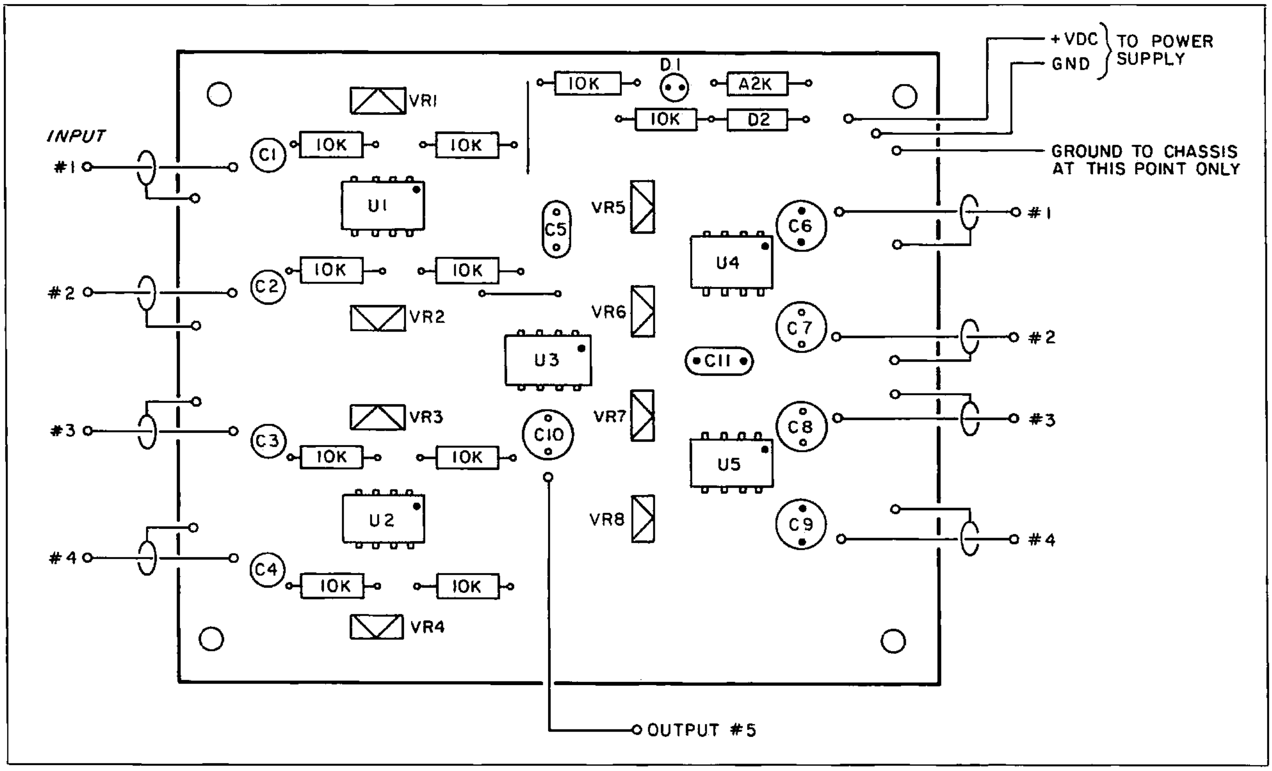


Figure 6. Mixer component layout.

Good Mobile Audio— For Pennies

Conveniently feed rig audio to your car speaker system.

by Paul M. Danzer N1II

Once again, I put a new 2 meter rig in my car, and once again, I was disappointed. There is always a lot of high mobile ambient noise in a car. Combine this problem with the small size of the speakers provided with most 2 meter rigs and you end up with with a sound system that just does not provide the clean distinct audio we now routinely expect from modern ham equipment.

Whether this is due to the speaker or to the small size of the audio amplifier is debatable, but the poor results are evident. Years ago, there was plenty of room to neatly add an external speaker to solve the problem. Today's automobiles are much more cramped.

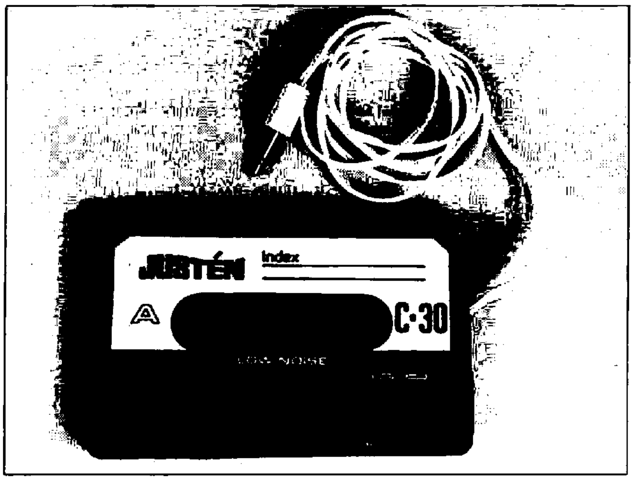


Photo A. The assembled unit to pipe your rig's AF to your car speaker system via the cassette tape pickups.

Solution

Fortunately, today's cars also often have four speakers mounted for the AM/FM radio and cassette player.

The first thought you might have is to open up one of these speaker lines and share it with the two meter rig. On second thought, the problem of switching back and fourth between the ham gear and the entertainment gear gets quite messy.

The answer to this almost universal problem is in the cassette player. Figure 1 shows how to do it.

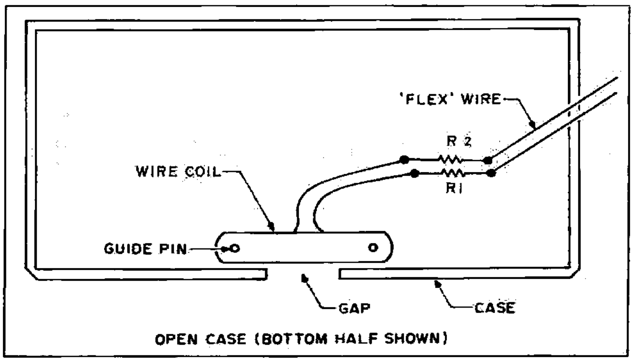


Figure 1. Inside of the cassette tape. Wind 4–5 turns of 28–36 gauge wire around the guide pins.

Start out with a standard audio cassette. If possible, obtain one which can be opened by unscrewing 4 or 5 Phillips-head screws. If necessary, you can use the glued units, but this makes opening them up a little harder.

Next, strip out everything in the cassette. Now, when you look at the bottom half, you will see something like Figure 1, where on each side of the opening for the tape there are two guide pins.

Wind a small coil out of #28, #30, or even #36 enamel wire around the guide pins. The kind of wire to use depends on what you can get, and on what you can handle. (For some people, scraping the enamel off #36 enamel wire is a bit of a task.) For the winding, 5 to 10 turns will be enough. The actual number isn't critical—you'll still end up with plenty of gain for the audio.

The resistors in the figure are there to prevent short-circuiting the audio amplifier. I suspect that the resistors are not really necessary under many circumstances. If the small coil looks like a few ohms (say 4 ohms), no resistors are needed. I prefer to take no chances so I raided my junkbox and used a combination which provided a value of 2 ohms—just to play safe.

Finally, take a length of flexible fine wire, like the kind used for miniature speaker or earphone connections, and lead the wire out of the cassette. Chose the edge of the cassette which will be clear when the cassette is inserted into your cassette player. For some units, you will have to use one short edge, as shown in Figure 1. For other units, the rear (long) edge is the only one clear.

After closing up the cassette, connect a plug to the "flex" wire to match your rig's external audio output jack. Insert the cassette, turn the player and your rig on, and admire the audio. Two front speakers, two rear speakers, front and back fader, left and right adjustment, bass control, treble control, a couple of Watts per channel—what else could you want? ■

73 Review by Bill Brown WB8ELK

PC Electronics' TX-33

PC Electronics
2522 Paxson Lane
Arcadia CA 91006-8537
(818) 447-4565
Price Class: $300

ATV on the spacious 902–928 MHz band.

Come on up to 900 MHz! The higher bands available to ATV operation are relatively clear of interference from other modes. Also, operation on the higher frequencies lets you operate full duplex ATV with stations active on 70cm! When used as a cross-band repeater input or output, it's now possible to see the repeater while transmitting through it. A 900 MHz system makes weather radar inputs and linkups to other ATV repeaters simple.

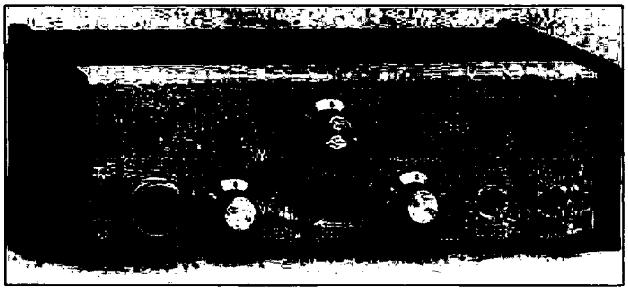


Photo A. Front view of the TX-33.

PC Electronics has made it easy to enjoy this band with the introduction of a complete 900 MHz ATV transmitter, Model TX-33, with a built-in sound subcarrier. The Model TX-33 is housed in the same style cabinet as their other systems. It should stack nicely in your hamshack. They also offer a repeater version in a Hammond die-cast box, the RTX-33.

Using the TX-33

The TX-33 has a 1 Watt PEP output with an adjustable blanking pedestal. You can adjust your transmitter for proper operation with various amplifiers, such as the Down East 18 Watt model. There is a built-in T/R relay, which routes the antenna through to a companion downconverter. Two front panel controls let you adjust the microphone and line audio inputs independently. A TV camera can be connected by means of a 10-pin connector on the front panel. There is a rear panel RCA jack for connecting a VCR, computer, or cam-corder. A front panel switch selects the video source.

Monitoring your transmissions on your receive TV setup can give false readings due to overload and reflections. The TX-33 has a demodulator circuit onboard which allows you to monitor the actual transmitted signal via a monitor or TV camera viewfinder. This way, you can adjust the video gain control properly instead of relying on feedback from distant stations.

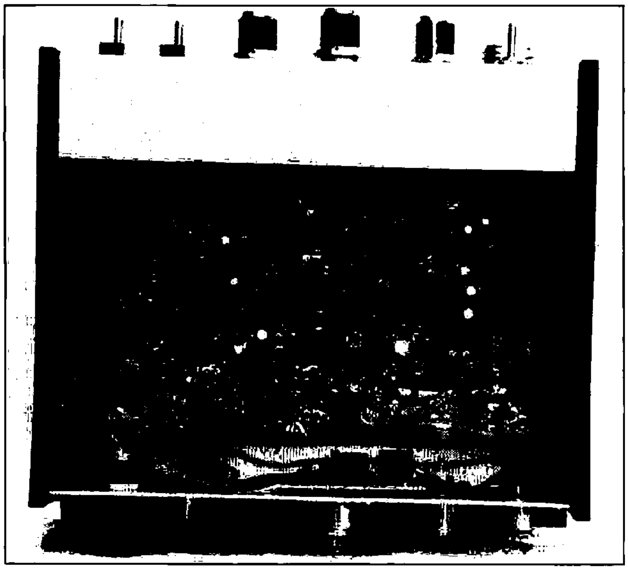


Photo B. Top view of the TX-33's internal PC board.

There is also a push-to-look (PTL) input, similar to a push-to-talk function, that allows you to remotely key the transmitter.

Performance Tests

The TX-33 draws 500 mA at 13.8 volts during transmit. I measured the PEP power output (sync tip) at 1.75 Watts, and the subcarrier sound at −20 dB, referenced to the visual carrier. Upper 2X sound was −55 dB, and lower 2X sound was −43 dB. Subharmonics were well below −50 dB. I didn't detect any spurs or crystal harmonics below the test frequency of 910.25 MHz. The sound subcarrier reached 28 kHz deviation before distortion. Colorbar and multiburst tests indicate an excellent response over the full video bandwidth.

It Would Be Nice If...

The TX-33 had vestigial sideband (VSB) signal capabilities, but it transmits only double sideband (DSB). Not to worry, though—there are external filters available for VSB. They are available from *Spectrum International, PO Box 1084, Concord, MA 01742; PH: (508) 263-2145* and *TX/RX Systems, 8625 Industrial Pkwy., Angola, NY 14006; PH: (716) 549-4700.*

Let's See You on 33cm

The TX-33 produces a very clean signal with high quality video and audio. This rig should help make it easier to enjoy the advantages of the increasingly popular 900 MHz band.

Note: Popular ATV frequencies are 910.25, 911.25, and 923.25 MHz.

Low-Band Wonder

Inexpensive good gain antenna for 80–20 meters.

by Bill Clarke WA4BLC

IF shifts, notch filters, preamps, filters, and all those other sophisticated signal-enhancers of today's rigs are wonderful, but they all need a signal to shape. So, as it has been from the very beginning, it comes down to having a decent antenna system.

It's often difficult to impossible, however, to find a single antenna to adequately fit all your needs—gain, space efficiency, low-cost, directionality, etc.—especially if you like to operate on the lower HF bands. Directional beams certainly give you the gain, but at what cost? You need the space to erect it and, with the price of aluminum these days, fewer hams can afford even the hardware to "roll their own." And you still need to buy a rotator and control box to aim it where you want.

This problem leads many of us to keep several antennas, each for a specific job. After many years of experimenting, I still haven't found the elusive "be-and-do-everything" antenna. The Low-Band Wonder, however, is one of the better well-rounded antennas I've run across in a long time.

Loop Scoop

This antenna is *basic*. A loop antenna is a closed wire loop that, in free space, radiates perpendicular to its plane. This radiation pattern is bi-directional. Because of this, when you orient the loop horizontally and load it, one of the two lobes radiates upward in all directions.

Loop gain is about 2 dB over a dipole. Furthermore, since it is a closed antenna, it is less susceptible to static noise.

The accepted formula for a closed loop antenna is 1005/freqency (MHz). The results will be in feet. Radiation resistance, theoretically, will be about 100Ω at the design frequency.

Loop Construction

The horizontal loop antenna I use is about as simple as any antenna can be. It is a wire 260 feet in length, held in place at four points to form a 65' square. When you cut the wire at length, connect the center insulator to one end, and choose where you want the feedpoint to be positioned.

The shape can be altered to fit most locations (circle, pentagon, rectangle, etc), as long as it doesn't deviate too much from the basic loop shape.

Mounting height is flexible—try to keep it in the 20–40 foot range. I mounted mine at 25–35 feet, and use trees as the supports.

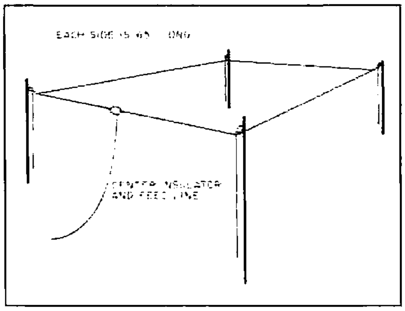


Figure 1. The erected Low-Band Wonder. Raise the loop corners to 20–40 feet.

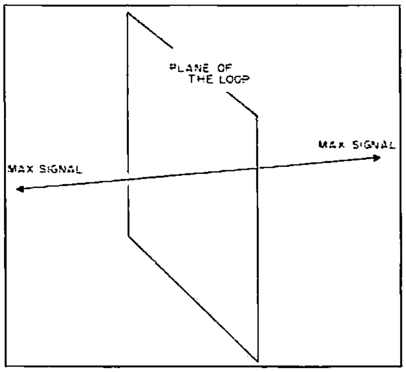


Figure 2. Maximum signal radiates bidirectionally from the loop center, perpendicular to the loop's plane.

Put your support insulators up (on push-up towers, corner of the barn, or trees), and fasten them in place with nylon "hamfest special" rope to allow for adjustment from the ground. You may want to use black rope—it has better resistance to UV light.

Lower each support insulator and feed the free end of your wire through each in order. Then, bring the wire around to the remaining side of the center insulator, and wrap and solder it.

Go to each support line and pull the insulator and loop up until it is near its final resting place. Avoid contact with branches and other antenna wires. BE CAREFUL—avoid power lines! Don't invite injury or possible death.

After you have raised the antenna, go back and make final height and tightness adjustments. Tautness requires only that the loop not be capable of excessive movement. There will be some slack between the support points, which is necessary, as the supports may move independently, causing stress on the loop.

Feedline length is not critical. I tried feeding the loop with twin-lead, open-wire feeders (4" spread), twin-coax, and plain 50Ω coax. I found the last to be the easiest to handle physically, and the most tolerant to tune. You will need a tuner to operate the loop as a tribander.

Now, just select your frequency and tune up as you normally would, adjusting the tuner for lowest SWR. Stand by for resounding signal reports!

Performance

Even though its high radiation patterns and resultant short skip doesn't make it a front-runner for DX, the loop consistently gave me excellent 20 meter signals within the US, and surprisingly good results on 75 and 40 meter DX into Europe.

I would appreciate hearing your comments and experiences with this antenna. 73

Parts List

260 feet of #12 to #18 hard-drawn or copper-weld wire.

200 feet of "hamfest special" nylon rope.

4 (or the number of proposed supports) high quality end insulators (Al-5 4 glass polymer by B&W).

1 center insulator with coax connector.

1 package of Coax-Seal.

Coax feedline in an appropriate length. Use RG-8X, except for very high power operation.

One stop mail-order shopping for the parts is available from: *Radio Works, Box 6159, Portsmouth, VA 23703, Telephone: (804) 484–0140.*

Number 15 on your Feedback card

ASK KABOOM

The Tech Answer Man

Michael J. Geier KB1UM
7 Simpson Court
S. Burlington VT 05403

Precision, Accuracy, and other Topics

Before we get into this month's topics, I'd like to respond to a few comments about my recent review of the Kenwood TH-25AT walkie. Several people wrote to say that it is, in fact, possible to defeat both the battery saver and the auto power-off functions. (Turning off the battery saver is especially important for packet operation.) They referred me to page 21 in the owner's manual, but on checking this, I found no such topic. Kenwood apparently amended the book with this new information.

Precision and Accuracy

My recent column, "The Versatile VOM," prompted a letter from Wendell KD5BF, who pointed out that precision and accuracy are not the same thing.

Indeed, they are not! Precision refers to the degree of specified detail, while accuracy refers to the truthfulness, or correctness, of the specified data. Here's an example: The TV weatherperson says that it will be between 40 and 60 degrees today. The actual reading turns out to be 53. Thus, the forecast was accurate, but not very precise. For tomorrow, the forecast is for 52.47 degrees at 4 PM. It turns out to be 61 degrees. This forecast was very precise, but completely inaccurate.

So what good is one without the other? Not much! The above examples show that precision is useless without accuracy, but that accuracy with little precision doesn't tell you much, either.

In electronics test equipment, manufacturers attempt to balance the two factors. For example, a 3½-digit DMM is accurate enough for the smallest (or "least significant") digit to mean something. A careful review of the specs on some units, though, can reveal that the stated precision, unsupported by the basic accuracy of the instrument, is something of a marketing gimmick. Other factors, such as the input impedance (which, if too low, can load the circuit under test), and the linearity of the analog-to-digital conversion process, can undermine accuracy. I stand by my earlier statement, though: in general, DMMs are both more accurate and more precise than VOMs.

RF Feedback and Hash

If you've got an amplifier, and especially if you use it with a wire antenna, you've probably run into the old "OM, you sure are distorted" RF feedback problem. Prevailing thought seems to be that if your station is properly grounded, and your SWR is low, it won't happen. Nonsense! Of course it shouldn't happen but, all too often, it does.

RF feedback means just that: RF from your transmitter/antenna system is feeding back into your station. The usual path is through the microphone cable, or even into the mike itself. Preamplified mikes are particularly susceptible, because the semiconductors in their low-level preamps make dandy rectifiers for the strong RF fields impinging upon them. Also, the more cables you have hanging off your rig, the more likely you'll have a problem. RF can be conducted through computer cables, speaker cables, even the radio's AC cord! Sometimes wrapping them through toroids helps, sometimes not. Generally, the less stretched out they are, the better. Try coiling them, moving them around, or disconnecting them one by one. Frequently, the path is through one particular cable, and the rest are innocent.

Sometimes the antenna is just too close—that's the situation at the home QTH. There's no problem during clear weather, but when there's ice on the roof, I get terrible feedback (even though the SWR is still 1.2:1). The ice apparently aids RF conduction back into the house. Thoroughly grounding the station hasn't helped. The antenna is only about 20 feet away, and that's just not far enough at the 700–800 Watt level.

Computer Hash

As computers become an integral part of more and more ham shacks, hams are discovering the frustration of coping with the spectral noise these machines generate. Computers are fast square-wave devices, and the harmonics of their varied internal frequencies can seriously degrade reception. Some machines, especially early, poorly shielded ones, are worse than others. I've heard of packet TNCs—computers in their their own right—wiping out the 2 meter signals they are trying to receive. On HF RTTY, the problem is even worse. Although some of the hash can be induced through the antenna, again, most is through cables, just as with RF feedback. Toroids help, and sometimes just moving the equipment around can provide significant improvement. This is one of those problems that's just about impossible to eradicate, but there's much you can do to reduce it.

Man Bites Dog

Yes, television sets can cause interference in your operation (I guess there's some justice in this world!). The color decoding circuitry puts out a nice signal on 3.580 MHz, and the sawtooth sweep currents generate harmonics well up through the HF bands. If you're hearing a buzzing noise every 15 kHz, a nearby TV set's horizontal sweep is the likely culprit.

Short of turning off the set, there's not much you can do. Most sets are in plastic cases, with no shielding around the picture tube yoke (the primary radiator) at all. And the front of the tube is a nice hash generator of its own. That flying electron beam, writing MHz of information at high velocities, can be a real noise-maker in the HF spectrum. Of course, if the offending set is not your own, its signals are a good indicator of when to keep your power down to avoid causing TVI.

Now, let's look at some letters.

Dear Kaboom,

I'm interested in getting my amateur ticket, and I've been trying to listen to SSB ham stations on my National NC-183D. I keep tuning the BFO to try to follow the drifting signals, but I'm not having much luck. Is there a circuit I can build to make SSB reception easier, or is the National just too old for this type of transmission?

Signed,
Drifting Off

Dear Drifting,

I'm not too familiar with that model (I'm a solid state guy), but in general, old AM rigs with BFOs are not well suited to SSB reception. For one thing, they aren't SINGLE sideband; they receive signals on both sidebands at once, making the interference from other stations seem much worse than it really is. Also, as you've found out, the drift is much too high. Short of designing a new VFO, there's not much you can do.

I recommend that you get a simple ham rig, such as a Heath HW-101 or a Kenwood TS-520. It'll work much better and, when you get your ticket, you'll be all set. Hope to hear you on the bands with your new ticket!

Dear Kaboom,

My trusty old KDK FM-2016A 2 meter mobile rig has an odd problem. It transmits off frequency, but only when using +600 offset. Simplex and −600 are fine. What gives?

Signed,
Off-Freq

Dear Off,

This radio uses three crystals, one for each offset, in its synthesis scheme. Crystal X2, located with the other two on the top board, controls the + offset. Try adjusting trimcap VC2. If that puts it back on frequency, then flip the "5UP" switch (on the front panel) to raise the frequency 5 kHz, and adjust trimpot VR1 so that the raised frequency is also correct. If VC2 won't do it, then you'll have to get a new 13.966 MHz crystal for X2. After installing it, be sure to perform the two adjustments to get it exactly on frequency.

Dear Kaboom,

I'm using a Robot 400 SSTV converter with a Panasonic PK-410 color camera. It works, but I get wavy lines through the pictures, especially on bright picture areas. The contrast and brightness controls on the Robot help a little, but not much. Where are those lines coming from?

Signed,
Caught the Wave

Dear Caught,

The Robot 400 is a black and white converter, and its digitization rate is aliasing with the chroma subcarrier coming from the camera, generating beat frequencies that show up as lines on the screen. You could try designing a 3.58 MHz chroma trap in the input stage of the Robot, but a far easier solution is to pick up a cheap black and white camera at your local hamfest.

Have a tech question? Send it off to "Dear Kaboom" at the above address.

Upgrade Your CDR Antenna Controller

Add on a high-grade remote antenna selector for under $20.

by John W. Swancara WA6LOD

While attending the local swap meet recently, I picked up a 4-position, electrically driven, coaxial switch assembly with high grade, type N coaxial fittings, all for ten bucks.

Several of my ham friends mentioned that it looked nice, and would be nice to use, but that it required +28 volts. That meant another power supply to buy or build, and run, as well as another control box to clutter up the operating position. But the price was right. Also, I remembered that my CDR HAM-M Rotator uses +28 volts DC to operate the rotator brake.

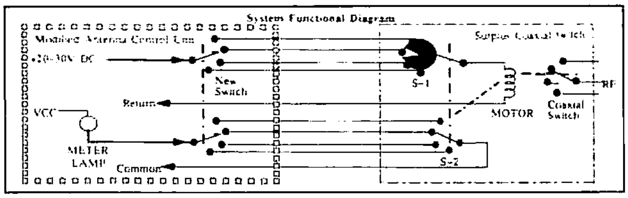


Figure 1. Remote antenna switch system diagram.

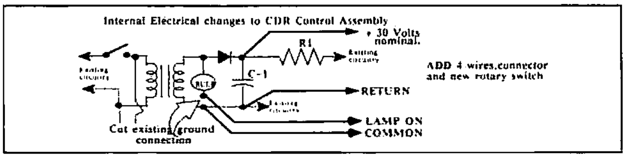


Figure 2. CDR rotator control box rewiring, to accommodate the remote antenna switcher.

I smuggled it past my wife and into my laboratory. Careful disassembly revealed the high quality of the +28 volt, motor driven, high power coaxial sector switch. The unit was manufactured by Weinschel Engineering. A phone call produced a schematic copy of the unit, as well as a reassurance that the item was more than capable of handling ham power levels. The retail price of this item quoted by the engineer would knock your socks off!

While waiting for the schematic to arrive, I tapped off the +28 volt diode and return inside my rotator control box and discovered that the motor drew only 350 mA of power. It also controlled a set of rotary switches (see Figure 1). The first one, S-1, was a 4-position normally shorted with one open, corresponding to the position of the coaxial switch. The second, S-2, was a standard 4-position with normally open contacts.

With the coax switch schematic and a little common sense rework, and CDR control head, I had a very capable remote controlled, 1 kW RF switching system built into my station, with only one coax line going from the HF rig to the outside world. I now access any of the following antenna systems: an 80/40m dipole, a KT-34A beam, a dummy load (under the house with the coaxial switch), and a 17m dipole (What a band!). Here's how to do it:

Modifying the CDR Rotator Control

1. Remove the calibration pot from the front panel and remount it on the back panel. You will seldom need it (Photo B).
2. On the back panel, punch out a hole for a (minimum) 10-pin female connector.
3. Obtain a 2-pole, 4-position rotary switch, and mount it on the front panel, where the calibration pot was located (Photo A).
4. Wire as shown in Figure 2, using your own pin assignments.
5. Add a small overlay on the panel face, with designations as required.

Modifying the Coaxial Switch

Essentially no changes are required. My switch had a very strange miniature 12-pin connector, easily replaced with a standard 10-pin DIN connector that even fit the mounting hole for the old connector (Photo B). The connectors were obtained from Radio Shack at minimum costs.

Operating Your Upgraded CDR

When you make a selection with the new switch, the meter light will go out, while the motor, which is now powered through S-1, resets to the selected position. The meter indicator light will illuminate when the remote selection has been made.

These surplus coaxial switches, as well as magnetic latched DPDT and SPST coaxial switches, are often available at very reasonable prices.

One thing to remember, as an RF engineer reminded me, is that if the switches have type N coaxial connectors, the switch is probably good for 1 kW. You can replace fancy Mil-spec connectors with DIN or equivalent connectors.

The total cost was a significant savings over the cost of several commercially available switches.

Happy hunting at the swap meets!

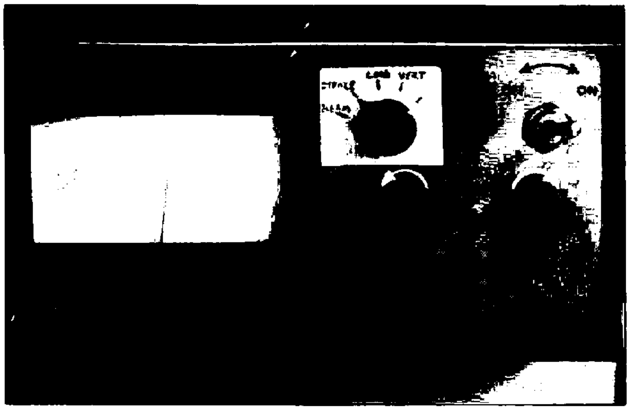


Photo A. Modified front panel of the CDR rotator controller, which now supports the remote antenna selector.

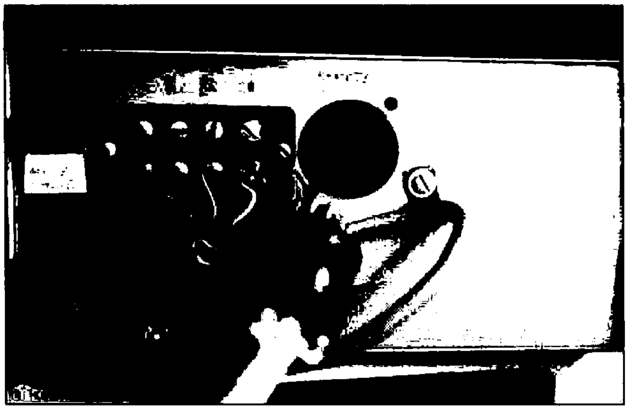


Photo B. CDR rear panel. The relocated calibration pot is at upper left.

plans for ever using 99.83% of your frequencies, yet you're angry when the FCC starts giving them to people who have real needs for them? Please explain this so I'll understand your reasoning.

Please don't tell me about Novice Enhancement and the new League stance on no-code—unless you can point to one single published goal for amateur growth that has been planned. There are no goals because, as far as I know, there are no plans for generating any significant amateur growth. I haven't seen any plans from anyone, have you?

Heck, I see very few amateurs even thinking about it. I get many of the ham club newsletters and they're almost 100% involved with the day-to-day news of their area. This repeater is having a battle with that one. This net is being jammed. That club had a picnic. This one visited the local FAA center. So-and-so worked a couple of new countries.

I don't see any grassroots concern over our unused bands, or any discussion of what to do about it. No, I see the deck chairs on the Titanic being rearranged, with angry battles over which one goes where and who will get to sit in it as the ship sinks.

Publish Or Perish

Few ham clubs are able to maintain their membership and strength without a dedicated club newsletter. It's the glue that helps hold a club together. It helps keep enthusiasm high and bring members to meetings—even if they have to tape Miami Vice to do it. It helps build participation in club events.

Producing newsletters used to be far more difficult and expensive than it is today. Mostly they used to be typed on mimeograph stencils. Drawings were possible but difficult, and photos were impossible. Then, as photo offset presses proliferated, pictures got easier to handle, but we still had to use typewritten copy, so it didn't look very professional.

Now, with Macintosh computers at every turn, cranking out very professional-looking newsletters is a snap. The odds are good you've got at least one club member with a Mac. Talking this person into producing your club newsletter is easy—just show an interest in desktop publishing and wait until the smoke clears.

Many instant printers now have Macintosh desktop publishing setups you can come in and use, paying by the hour.

Getting Material

Many clubs have me on their newsletter mailing list, which I appreciate. I like to know what's going on. Some newsletters are packed with interesting reports from members, others have pathetic admonishments from the editor pleading for material. How do the successful editors get their members to cooperate?

It's not that difficult, but it is necessary to bring some psychology into play. The worst approach is to try and shame people into writing. That not only doesn't work, it ruins the publication for the readers. Leave laying on the guilt to me. What does work is flattery.

If you have a DXer in your club, ask him if he can write a column telling what DX he's worked recently, perhaps including a couple of his prized QSL cards and the stories behind them. Then be sure to tell him how much his column is helping the newsletter, and how many compliments you're hearing about it.

Use the same approach with your leading packet club members, and with RTTY, SSTV, and so on. Find out the special interests of the members and get as many as possible to report monthly on 'em. Motivation is easy: They'll love the opportunity to brag and thus raise their stature in the club, and they'll do all they can to get other members to be involved with their passion. If you have any real pioneers or inventors, don't forget to encourage them to spread their fame worldwide with articles for *73*.

Have you any members who would benefit from getting business from club members? Insurance agents, printers, lawyers? Do a profile of them; run a picture of their shack; have them tell about their business.

For that matter, many of your club members will have some interesting ham related stories to tell. . . if you bother to ask. Who is the most interesting person in the world? Each person has one outstanding favorite: himself. So pump 'em for stories. If some member has been on a DXpedition—even if it was 20 years ago—get him to write it up for you. What was the most interesting QSO? Who is the most interesting ham he's met? Start asking people to write about themselves and your resources are unlimited.

Business meetings can be the death of a club, so use the newsletter as much as possible to get business out of the way. Make sure you have an executive committee and let them handle most of the business, then be sure to report it in the newsletter so members don't get surprises. The remaining business can be whipped through in a few minutes if it's been covered properly in the newsletter. Business kills clubs. It's inherently boring.

When you organize club events use the newsletter to drum up participation. You do this by emphasizing how much fun everyone is going to have. Fun is the key to participation. As soon as clubs aren't fun the attendance will dwindle. When events aren't fun for everyone, they'll blow away. So you have to make sure the benefits of participating in activities are understood by the members.

Get the wives to make the coffee break goodies instead of buying el junko supermarket doughnuts. Try to remember a basic of psychology: The more you get people to do for you, the more they'll like you. The more you do for them, the less they'll like you. So get members to work hard for the club—involve their wives too. Yes, it's actually possible for a ham wife to like a ham club. I realize that my credibility has sunk to a new low with that one, so give it a try and see for yourself. Heh, heh!

Club presidents should make sure the newsletter publisher gets lavish praise and recognition: at meetings, in talking with other members, during contacts over the club repeater, and in the monthly president's message in the newsletter. Lay it on thick.

Once you have a club newsletter going use it as a recruitment medium for new members. Put 'em on the complimentary list for six months or so before giving up. If you have interesting speakers or demonstrations at your meetings you'll get 'em to come out. But without the newsletter, how will they know what fun they're missing?

Newsletter editors can get lots of interesting information to fill empty pages from *Westlink*, put out by Bill Pasternak WA6ITF. This is an excellent source of fast-breaking ham news and well worth the cost. The amount of work this chap puts into his newsletter is incredible. I highly recommend it.

Selling Ads

A newsletter may be of tremendous value in building a club and keeping it strong, but it can be expensive to support. Here's where selling some ads can make a big difference—can actually make a profit. Hey, didn't you ever wonder why there are so many multimillionaire publishers? This will at least cut down on the membership dues needed—and could help buy a bigger and better repeater.

How do you sell ads? Well, you have to do your homework. You don't just start calling and visiting local merchants with an order blank in hand. I suggest you start with a demographic study of your readers. What is their average family income? How many own homes? How many cars do they have per family? How much do they spend on ham gear per year? You want to be able to show potential advertisers that they're missing a good source of business unless they advertise in your newsletter.

Potential advertisers are going to want to know about what readership you've got for them so they can assess the advertising potential of your newsletter. Write this up in a one-page presentation.

What should you charge for ads? Well, how many copies are you distributing? If you have 100 readers you might charge $10 for a page, $6 for a half page and $4 for a third page. You don't have to go smaller than that.

Who are your best advertising prospects? They're all over the place, and local ham dealers are solid gold, of course. . . if you have any. Local ham manufacturers are great, too. But the chances are you're going to have to depend more on local merchants (real estate, photo shops, liquor stores, satellite dishes, car sales, restaurants) and services (plumbing, car repairs, TV repairs).

See that all ad prospects get a brochure on the advantages of advertising in your newsletter. It's a great medium for a discount coupon, by the way.

All this will be lost unless you make sure the members patronize your advertisers. Explain that this is the main difference between America and Russia—here our small businesses are the strength of our country. But small businesses need to have you buying from them, so reward your advertisers with business. With any club cooperation you should be

Continued on page 90

ATV Transmitter from a Microwave Oven!

Low-cost high-power microwave operation has arrived.

by David Pacholok KA9BYI

WARNING

The following construction project is not intended for novice builders! If you are not qualified to work with 5000 volts and 500 Watts of microwave power, DO NOT attempt construction of this transmitter. The above power level in the microwave region can be lethal. The author, David Pacholok, and 73 Magazine disclaim any responsibility from mishaps resulting from the construction and/or operation of this project.

The majority of the amateur spectrum allocation lies above 1300 MHz, yet when you scan those bands, you rarely hear anything but band noise. Hams have let these regions lay fallow because of the idea that microwave equipment is complex, expensive, or just unavailable.

To be sure, there are concepts unique to microwave design, but they are not necessarily harder to grasp than those in lower frequency RF design. And, as microwave applications find a larger place in society, as with ovens, and satellite TV, affordability and availability of surplus microwave equipment constantly increases.

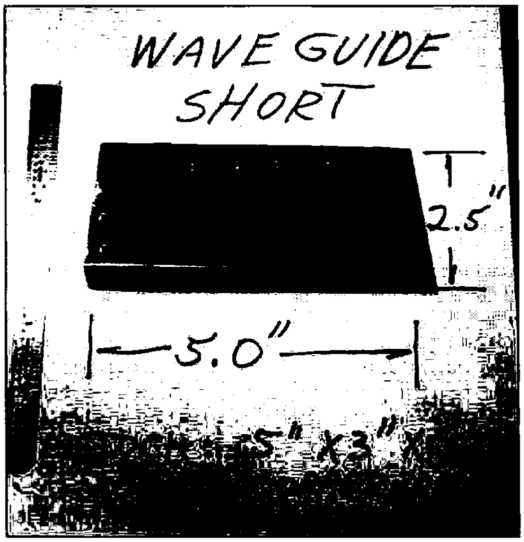


Photo A. Waveguide shorting plate, to prevent the microwave RF from entering the cooking chamber, and to reflect this energy back to an E-field probe.

Project Features

The goal for this project was to provide an inexpensive, relatively simple high power microwave transmitter using a microwave oven as the foundation. This project meets the following goals:

- Low cost—less than $200.
- High power output—250 Watts minimum.
- Parts readily available from consumer electronic supply houses.
- Emission type compatible with standard low-cost B/W television receivers.
- Frequency of emission in the 2390–2450 MHz amateur band, compatible with Multipoint Distribution System (MDS) TV downconverters. (Historically, these downconverters have been misused to "pirate" television movie distribution at 2156 and 2162 MHz. They have been widely sold through magazine advertisements and electronic flea markets, so there are tens of thousands of them in existence.)

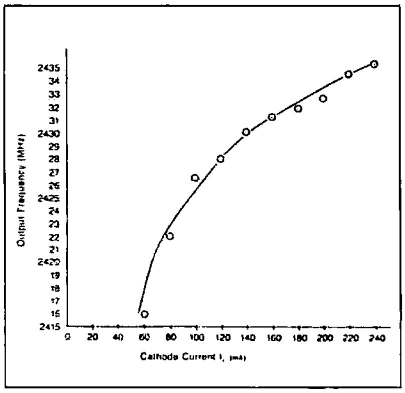


Figure 1. Graph showing frequency versus I_k for the magnetron. This shows that output frequency is (non-linearly) related to current to the magnetron.

- The basic transmitter scheme is adaptable to other emission modes, such as narrowband FM, with phase-lock circuitry described below.

Modification Description

A microwave oven magnetron is a self-contained, crossed-field power oscillator. Built-in cavities primarily determine oscillation frequency, with anode voltage and magnetic field having a secondary effect on this.

First, I modified the magnetron cavity to couple RF to a transmission line instead of to the oven compartment. I removed the interior radome/splatter cover, field stirrer blades, and magnetron output matching section. Next, I shorted the waveguide open end with a plate (Photo A) and installed an E-field probe to couple the RF to an N-connector output jack. (Photo B shows the details of the construction of the E-field probe.)

Magnetron current, voltage, and frequency were measured and plotted independently to quantify performance in this modified cavity. In power output vs. cathode current measurements, for a power out range of 50–400 Watts, and a cathode current of 50–250 mA, I found a very linear relationship. See Figure 1 for the frequency vs. current curve. This data suggests that:

1. The 2M189A magnetron is a current-operated device. The anode-to-cathode voltage changes only about 1 percent, with a 2:1 change in cathode current I_k.
2. Power output is a linear function of I_k.
3. Output frequency is a non-linear (but monotonic) function of I_k, with increased current causing an operating frequency increase. The average frequency "pushing" coefficient is about 0.1 MHz/mA, with a useful frequency swing of about 20 MHz.

What Mode To Use?

The above conclusions ruled out AM double-sideband video, because of the large incidental FM that would result. On the other hand, an FM deviation of 2 MHz would cause incidental AM of only 15–20 percent, so I investigated wideband FM video transmission.

To check compatibility with existing TV receivers, I used an FM video-modulated signal generator as a signal source for an MDS downconverter and a 5-inch monochrome receiver. I got a fair quality picture with the television adjusted for IF slope detection, and with sync and vertical lock achieved at deviations of 700 kHz to 3.0 MHz. The best picture quality occurred at 2.2 MHz deviation.

Modulator Circuit Description

The modulator serves two purposes. First,

it is a high-voltage current source with high open-loop gain, setting the magnetron current to a known value, and establishing a frequency and power output. See Figure 2. U2, a 7805 5-volt regulator, establishes a reference voltage adjusted by R5 and R6. This voltage is applied to the non-inverting input of high-speed op amp U1, which drives source follower Q1. The output of Q1, plus R9 and R7, provide negative feedback to U1 in the ratio 5.7:1. At equilibrium, Q1's drain/source current produces a voltage drop across R11 that equals 5.7 times U1's non-inverting voltage.

Temporarily ignoring screen grid current, plate current equals cathode current in V1 (a,b combined). Since V1's cathode current equals Q1's drain current, V_D rises or falls until the V1 grid 1-to-cathode bias causes $I_P = I_k = I_D = I_S$. V1 is therefore a grounded-grid voltage amplifier with a current gain of unity, with enough voltage capability to drive the magnetron. However, to an input voltage at U1, a transconductance amplifier is formed, with transconductance given by:

$$\frac{\Delta I}{\Delta V}\left(\frac{R9+R7}{R7}\right)\left(\frac{1}{R11}+\frac{1}{R9+R7}\right)=.22\mho$$

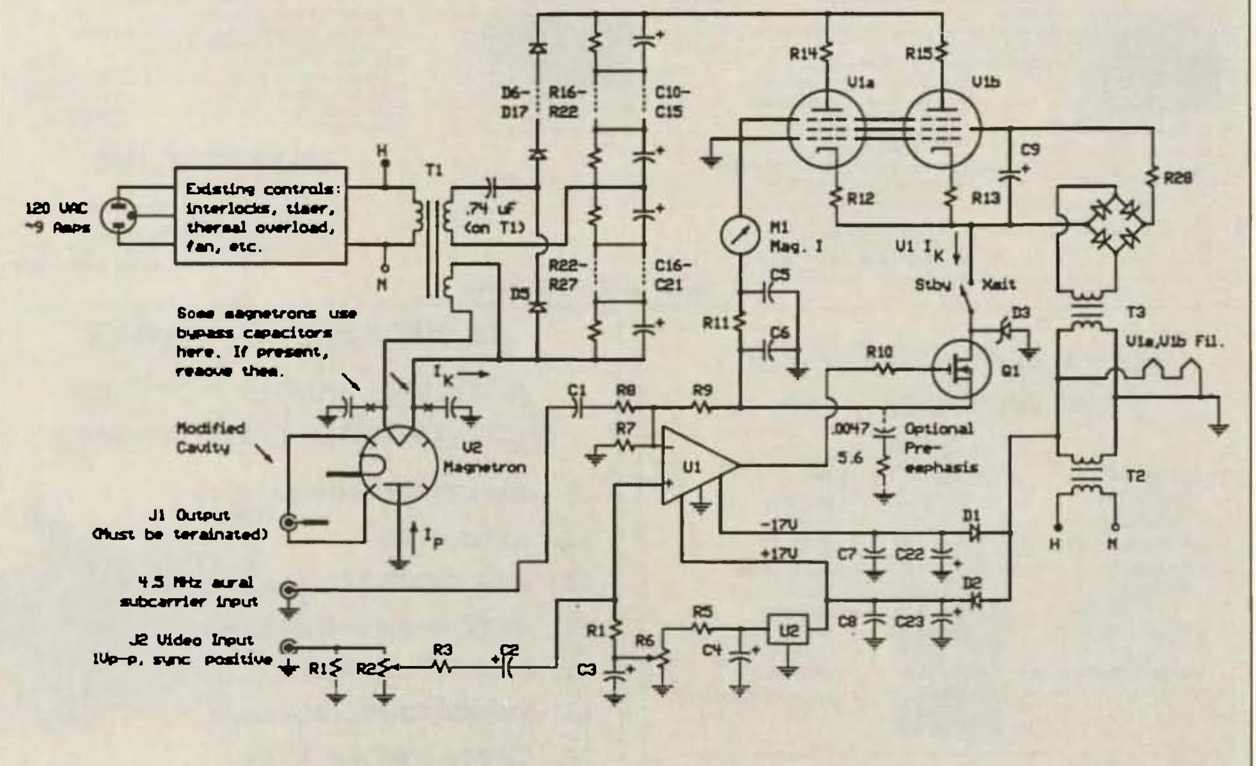
Bandwidth of this amplifier must be sufficient for the modulator's second purpose—video modulation. This must be 4.5 MHz, if you want to include the audio subcarrier. Frequency response measured with a current probe in the plate leads of V1 was down 4 dB at 4.5 MHz. Adding C6 (1200 pF) provides a pole for this frequency, flattening the response to beyond 6 MHz. C1 and R8 serve to couple an external 4.5 MHz subcarrier generator to the modulator.

A floating screen supply of about +100 volts is provided, with R28 included to limit screen dissipation. The floating supply allows only plate current (magnetron current) to be included in the control loop. Additional components with functions are:

- •R3, R14, and R15, which prevent parasitic oscillation in U1 and V1.
- •R12 and R13, which aid current sharing in V1a and V1b.
- •D3, which protects Q1 in the case of V1 arc-over.
- •Conventional power supply rectifiers, filters and bleeders.

Waveguide/Cavity Operation

The waveguide circuit is deceptively simple: The oven's TE_{10} waveguide feed (from tube to cavity) is shorted with a copper plate.



Oven	400-500 watt consumer microwave oven. Suitable models include Hotpoint RE6002, Whirlpool MW 1000XS-0 or MW 1200XS-0, Tappan 56-1007-10/02, and Goldstar ER-4020
V1a,b	6JE6/6LQ6
V2	2M189A or 2M226A magnetron
Q1	VN66AF or similar power FET
U1	LF357 wideband op amp
U2	7805 regulator
D1, D2	1N4001
D3	1N4760, 68V, 1W zener diode
D4	1 amp, 200 PIV bridge rectifier
D5	10 kV, 250 mA diode
D6 - D17	1N4007
C1	.001 uF ceramic
C2	10 uF, 25V
C3, C4	100 uF, 10V
C5	330 uF, 6.3V
C6	1200 pF polystyrene
C7, C8	0.1 uF ceramic
C9	47 uF, 160V
C10 - C21	100 uF, 400WVDC
C22, C23	470 uF, 25V
R1	390 ohm
R2	100 ohm panel-mount potentiometer
R3, R6, R9	470 ohm
R4, R5	3.3 kohm
R6	1 kohm p.c. mount potentiometer
R7	100 ohm
R10	22 ohm
R11	27 ohm, 1 W
R12, R13	120 ohm, 1 W
R14, R15	100 ohm, 1 W
R16 - R27	470 kohm, 1/2 W
T1	Magnetron plate and filament transformer
T2	117 VAC to 12.6 VAC 3.0 A
T3	117 VAC to 12.6 VAC 450 mA
M1	0-200 mA DC
S1	SPST, 0.5 A 125 V
J1	Type "N" female panel mount connector

Figure 2. Transmitter schematic.

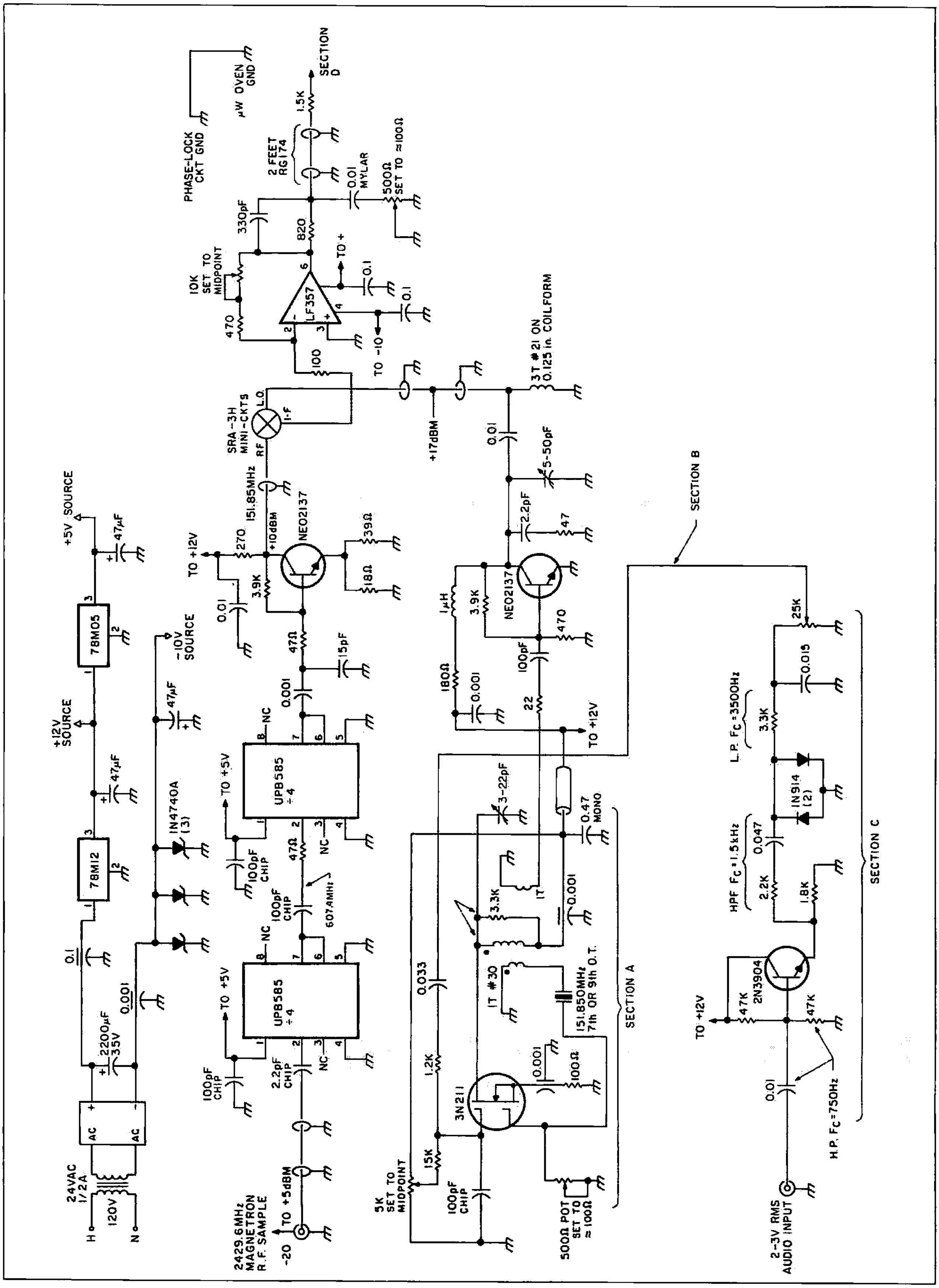


Figure 3. NBFM phase-lock system schematic.

(See Photo A). This is analogous to a coaxial or microstrip short, where wavefronts are reflected back with a 180 degree phase inversion. At a quarter guide wavelength from the short:

$$\lambda g = \frac{\lambda}{\sqrt{(\lambda/\lambda c)^2 - 1}}$$

where λc = 2X guide broadwall dimension.

The reflection is in phase with the incident wave from the magnetron, and an E-field probe (see Photo B) is inserted at this voltage maximum. Ordinarily, maximum power transfer occurs when this probe is $\lambda/4$ in length. Deliberately shortening the probe introduces a reactive mismatch at the magnetron output port. After an unknown number of degrees rotation within the feed structure (Matsushita would not provide tube data), this causes the magnetron to be pulled lower in frequency by some 25 MHz from its design frequency, ensuring legal amateur band operation.

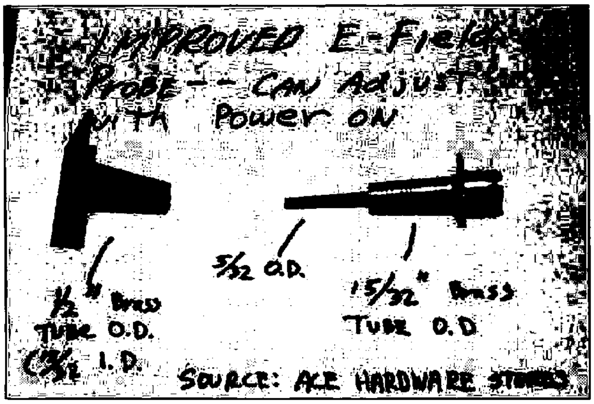


Photo B. E-field probe construction details.

Floating Operation

One important feature of this conversion is the modification of the high voltage power supply for floating operation. The original power transformer had one end of the secondary grounded to the frame. I lifted this end and attached it to a high-voltage lead wire. This modification eliminates the need to float the entire modulator above ground, which also requires video-bandwidth opto-isolators. Hi-pot tests at twice the rated voltage confirmed that the modification was reliable.

EME Anyone?

Narrow band FM (±5 kHz deviation) requires a clean RF source low in noise and incidental FM. You can use the phase-lock or frequency-lock loop, as shown in Figure 3, with the non-inverting input of U1 equivalent to the varactor control voltage in a conventional VCO.

The following notes discuss sections of the phase-lock circuit, and tell how to wire this circuit into the transmitter unit.

Refer to Section A on the schematic—the overtone VXO circuit. The entire unit should be temperature controlled at 70°C by "crystal ovens," or something similar. The oscillator drifts at around 100 Hz per degree, causing about 1.6 kHz per degree for the frequency out drift. Stability is traded off for simplicity in this design.

Refer to the 151.85 MHz crystal in the VXO circuit. Choose this crystal after you build the oven video transmitter and measure the stable operating frequency range using one UBP585 and a 600 MHz counter.

Now refer to the crystal oscillator tank coils, to the upper right of the crystal on the schematic. You fabricate this by winding six turns of #24 wire on a 3.3 k ½W carbon resistor. Then, wind one turn of feedback winding, tightly coupled, and one turn of output winding, loosely coupled.

Now look at Section B, the connection between the VXO and the IOC. There is about 0.6V PEP for 300 Hz VXO deviation, which results in about 5 kHz of magnetron deviation. The VXO deviation is linear up to about ±10 kHz output (magnetron) deviation.

In Section C, the IOC is cheap 'n' dirty, but plenty effective. The *Handbook* has a better—and more complicated—version of this.

Finally, at Section D, find the two-foot lead of RG-174 that comes off pin 6 of the LF357 IC. Attach this to pin 2 of U1 in the transmitter circuit (Figure 2). Before doing this, however, be sure to remove the 4.5 MHz audio subcarrier at R8, and the video input.

You have now converted the microwave oven transmitter to use with NBFM (±5 kHz) voice mode! Now adjust the magnetron cavity probe length and R6 until the magnetron locks up at all times during the magnetron anode warmup (5–7 minutes).

Transmitter Improvements for NBFM

- •Bypass D5 and D6–D17 with 0.0005 to 0.001 µF 3kV minimum caps. This reduces "hum bars" in the picture and low-level audio buzz in the NBFM mode.
- •Isolate the metal case of the 0.74 µF (on T1) capacitor from ground with plastic blocks, nylon screws, or other means. This will also reduce hum bars and buzz.
- •Using insulated standoffs, isolate T1 laminations, and frame from ground. This will further reduce hum bars and buzz, and will result in better insulation in T1 after mods.
- •Disconnect the magnetron filament feedthrough from ground! Otherwise you won't get full video bandwidth, and the NBFM mode PLL filter won't work (no phase margin). See Photos C and D.

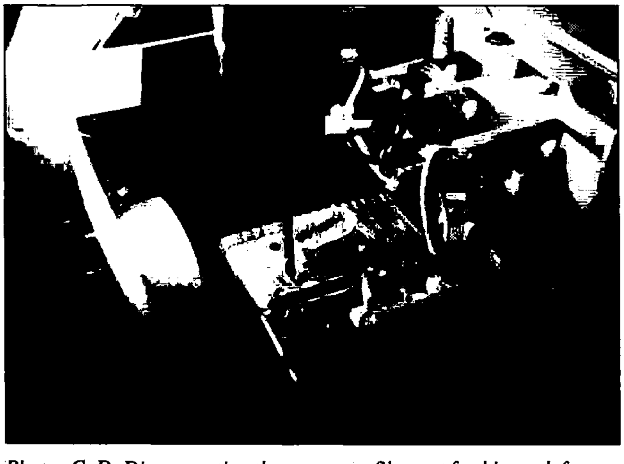
Performance

Spectrum analysis indicated the performance of the transmitter. The 1st Bessel null display (I_k = 160 mA, V_p = 3500V, Mod. index = 2.4, Mod. freq. = 1 MHz, and center freq. of 2.431 GHz) shows that the modulation is primarily FM.

Additional Comments and Observations

The following notes may or may not apply to the system if the NBFM phase-lock system is installed.

Warm-up drift is significant over the first ten minutes of operation, representing about



Photos C, D. Disconnecting the magetron filament feedthrough from ground. Drill out the rivets (Photo C) and push feedthrough 3/16" into sheet metal box of magnetron, and then epoxy in place (Photo D).

Photo E. Microwave leakage detector—a must for this project!

15% of the available tuning range (2.5 MHz).

Avoid magnetron "moding," appearing on a spectrum analyzer as a comb instead of a CW signal. This can be caused by a VSWR greater than 1.5:1, or by operation below about 50 mA. If low power operation is desired, raise the filament voltage to 3.4 – 3.6 V, since internal RF contributes to proper filament (cathode) temperature in normal operation.

If used with a true FM television receiver, such as a modified satellite TVRO unit, the simple pre-emphasis network shown on the schematic diagram will improve video S/N by up to 10 dB. Also, TVRO receivers use greater than 20 MHz IF bandwidth, greatly reducing the effects of warm-up drift.

Small "hum bars" are visible in the picture, due to the floating high voltage power supply. This effect is caused by the 60 Hz switching of the diodes, varying the capacitance to ground at the magnetron cathode. These transients are out of the control loop. Grounding the power supply and floating the modulator at high voltage is a solution, as is floating the magnetron and cavity. Either would increase circuit complexity and increase exposure to hazardous voltages.

As with any non-locked oscillator, a change in system load impedance will change the frequency of operation. A high power isolator is one solution, albeit an expensive one. I used a stretch line to measure the load pulling effects of a 1.5:1 VSWR over all phase angles. The frequency changed ± 6 MHz as the phase angle varied. At the design frequency of 2430 MHz, all modulating products should remain within the amateur band. This is not a trivial problem, and may require line trimming or line stretchers to place the phase angle in a stable region. The lowest possible antenna VSWR is the best solution to the line-pulling problem.

Beware!

Remember, for this project, SAFETY IS PARAMOUNT! This transmitter has 4 kV DC and high power microwave energy present. Use a microwave leakage detector to check the integrity of the modified unit (see Photo E). You can buy an inexpensive detector suitable for the job. Also, retain the door interlocks (I installed the modulator in the now-unused cooking cavity.) Antennas can easily have high gain at this frequency—DO NOT POINT THEM AT PEOPLE OR OTHER LIVING BEINGS!

Although this is not a "high performance" television transmitter, it represents a low-cost effort to achieve significant power output at microwave frequencies.

Readers interested in finding out more about this project can contact the author for details, at *Creative Electronics Consultants, 1815 W. Higgins Road, Sleepy Hollow, IL 60118, Telephone: (312) 428-5676.*

Article materials, except the phase-lock system, were drawn from the March 1989 issue of RF Design.

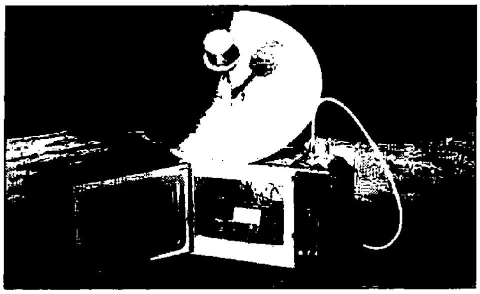


Photo F. The complete microwave oven ATV transmitter unit. The transmitter circuit is located in the oven's cooking chamber.

AERIAL VIEW

Antenna News

Arliss Thompson W7XU
RR 3, Box 224
Sioux Falls SD 57106

Mobile HF Antenna Modification

This month's column describes a simple, easily-reversible modification to the standard Hustler mobile antenna that will yield a substantial (2 to 3 dB) improvement in its performance. HF mobile operators using other brands of antennas may be able to realize similar gains, depending on their design, by using the methods discussed here.

Mobile Antenna Limitations

By far the majority of HF mobile antennas are short vertical whips. The mobile environment places severe restrictions on antennas, foremost of those restrictions being a limitation in antenna size. To understand why short antennas are a handicap in mobile operation, you must first recall that the radiation resistance of a vertical antenna is proportional to its length. The shorter the antenna, the lower the radiation resistance.

A low value of radiation resistance in itself is not bad, but for any antenna to radiate efficiently, most of the applied power must be "dissipated" in the radiation resistance. An antenna with low radiation resistance will operate efficiently only if other losses are kept very low. Those other sources of loss include power lost in any loading coils, and power lost in the ground. Therefore, to radiate the strongest signal possible, the radiation resistance needs to be maximized while the coil and ground losses are held to a minimum.

At a home station, it is possible to build an efficient short vertical antenna by using a large number of ground wires to minimize ground losses, and using well-designed coils in order to keep coil losses at a minimum. In the mobile setting, however, coil size is limited by wind-loading, and there would seem to be little control of ground losses, which tend to be relatively high. Since the antennas used on vehicles tend to be quite short (in terms of wavelength) while ground and coil losses are fairly high, mobile antenna efficiency on the lower HF bands tends to be dismal. By dismal, I mean feeding 100 Watts of your 3.9 MHz signal into the antenna, but having only 5 (!) Watts radiated; the other 95 Watts heat the loading coil and the ground. What can we do to improve on that low efficiency? I'm glad you asked.

Making the Best of It

A few years ago, the ARRL published a book entitled *The ARRL Antenna Compendium, Vol. 1*. One of the articles in that book was "Optimum Design of Short Coil-loaded High-frequency Mobile Antennas," by Bruce Brown W6TWW. That article contained much good advice on mobile antenna installations (most of the information also occurs in the latest [15th] edition of *The ARRL Antenna Book*). His advice, in short, was to maximize radiation resistance and minimize coil and ground losses. He also provided some suggestions on how to carry out these recommendations.

Offhand, there would seem to be little a mobile operator could do to minimize ground losses short of driving his car into the surf on his next visit to the beach. Some experimentation by Mr. Brown, though, indicated that ground losses could be markedly reduced by mounting the antenna as high above ground as possible. That means, all else being equal, that mounting your antenna near the top of your vehicle will give better signal strength than if it's bumper-mounted.

As an example of the magnitude of that effect, he reported a ground resistance of 2.5Ω with the antenna mounted near the roof of a station wagon, but 6Ω when bumper-mounted on a mid-sized sedan. This change in ground resistance is further compounded by the lower radiation resistance of base-loaded antennas, compared to center-loaded verticals. Base-loading a bumper-mounted mobile antenna therefore results in reduced efficiency because losses are increased while radiation is simultaneously decreased.

Now consider coil losses. Here, the base-loaded antenna would seem to have an advantage over the center-loaded whip because it requires only half the value of coil inductance to attain system resonance than the center-loaded whip. However, if that coil is mounted near metallic surfaces, it is likely to have losses greater than anticipated. That is important to consider if you plan on bumper-mounting a base-loaded antenna.

It may come as a surprise to some, but loading coils manufactured for commercial antennas are not of optimum design. For greatest Q, and lowest losses, a loading coil's diameter should be twice its length. I doubt you've seen many mobile coils with that shape. The problem with optimally designed coils, of course, is wind-loading. It doesn't do much good to have an ultra-low loss coil for 75 meters when the thing won't stay in one piece on the road.

Another problem for those of us who try to make our own, more efficient, loading coils is that they can be difficult to protect from the weather. I have had commercially manufactured coils that were so severely detuned after driving all day in torrential rains that they were completely useless until brought in and dried out.

The same can happen, and often does, with coils you manufacture yourself. And, of course, there is also the mechanical problems associated with building your own coils and integrating them with other components. Therefore, all things considered, I decided to use stock Hustler coils (kW version) when attempting to modify the Hustler system.

Of the losses I mentioned earlier in this article, the one yet to be discussed is the power lost in the radiation resistance. Of course, this loss is desirable, since it represents radiated power. To maximize the transmitted (or received) signal, the radiation resistance needs to be maximized. The radiation resistance is proportional to the frequency and the length of the antenna, so we can increase our mobile antenna's efficiency by either going higher in frequency and/or making the antenna longer.

Longer is Better

Naturally, there are some limits as to just how long an antenna you can have while operating mobile, particularly if you mount the antenna high on your vehicle, but I felt that I could safely extend the length of my Hustler antenna and perhaps reap an increase in signal strength.

From a study of W6TWW's data and other information available in *The ARRL Antenna Book*, I estimated that by lengthening the mast section of the Hustler system by 36 inches, I would be able to obtain approximately 3 dB in increased signal strength. I arrived at those figures by first finding the loading coil reactance of an 8-foot antenna tuned to 3.9 MHz with the loading coil placed 4.5 feet above the base. True, although the Hustler resonator is mounted 4.5 feet above its base, the overall length is somewhat over 8 feet. Nevertheless, I assumed that the value I obtained would be somewhere in the ballpark, and proceeded with the analysis.

Alongside the data for the loading coil reactance for an 8-foot whip, was similar information for an 11-foot antenna. Since I planned to use the same coil (and therefore the same inductive loading reactance) for my modified antenna, I simply read from Brown's graph what height the loading coil should be above the base of an 11-foot antenna—approximately 7.5 feet, or 3 feet higher that the coil's original position.

The next step was to estimate what 3 extra feet in mast length would buy me. Mr. Brown provided some radiation efficiency data in his article that compared the efficiencies of 8- and 11-foot whips with various combinations of ground losses and coil Q. Study of those curves indicated that it should be possible to gain as much as 3 dB on the 75 meter phone band by going from an 8-foot to an 11-foot antenna, other factors being equal.

That value could also be obtained by comparing the differences in radiation resistance between 8- and 11-foot antennas ($RR = h^2/312$, where RR is radiation resistance in ohms, h is height in electrical degrees, and 312 is a constant). Three dB gain for the price of 3 feet of aluminum sounded good to me, so I found a section of tubing with the appropriate diameter and fitted it over the upper end of the Hustler mast with ample overlap for mechanical support. The extension tubing had a short lengthwise slit cut in the bottom end so that compression clamps could hold it in place on the Hustler mast. The far end of the tubing used for the extension was also slotted. Compression clamps held the shaft of a ⅜-24 bolt in place. The bolt was placed lengthwise in the tubing with threads exposed; it provided the

continued on p. 83

Number 18 on your Feedback card

HAMSATS

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
14714 Knightsway Drive
Houston TX 77083

Microwaves and Satellites

Hamsats complement this month's microwave topic. AMSAT-OSCAR-13 provides two modes for microwave Earth stations.

Mode L operates with an uplink centered on 1269.5 MHz and a downlink of 435.86 MHz. (A complete frequency chart is shown in the December 1988 Hamsats column.) The transponder, nearly 300 kHz wide, is activated for two hours per orbit whenever the satellite's antennas are aimed at the Earth's center. Stations running as little as 300 Watts effective radiated power (ERP) have made consistent CW contacts. Five Watts into a yagi with 18 dB gain works, but reliable SSB operation requires more power or a better uplink antenna.

Mode S, our newest satellite mode, uses 70 cm for the uplink and 13 cm for the downlink. The system was designed to perform successfully with 2.5 kW ERP on the uplink. Downlink signals were to be strong and equal to the telemetry beacon. Unfortunately, it hasn't been working out that way. In late April, Bill McCaa KØRZ offered an explanation of what is happening with the Mode S transponder.

The system was designed for two possible operational states. One is telemetry beacon ON and passband OFF, and the other is beacon OFF and passband ON. Due to what appears to be a component failure or wiring error, the command to activate the passband and turn off the beacon is not getting through from the main computer.

Contacts made via the S transponder are driving through a transistor switch that is biased off. During bench tests prior to launch, Bill discovered that signals could be forced through the passband while the beacon was on only when signal levels were increased by 20 dB. This uplink penalty means that to get a beacon-level downlink signal, an Earth station now needs over 200 kW ERP. This is a far cry from the 2.5 kW level originally anticipated, but all is not lost.

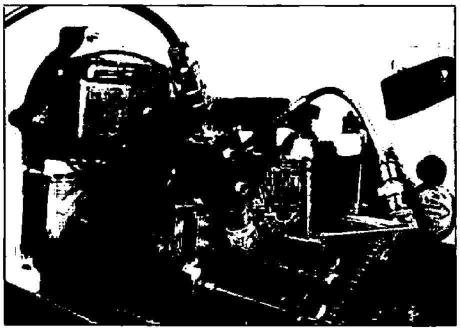


Photo A. Modified Adler 1.2 GHz amplifier ready for the Mode L 1269 MHz uplink.

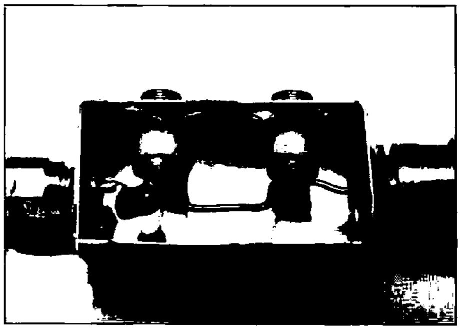


Photo B. Inside view of the new input tuning circuit.

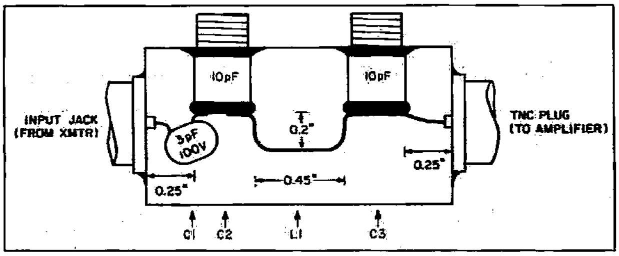


Figure 1. 1269 MHz amplifier input tuning assembly.

Although some operators are transmitting high power to a moonbounce antenna array, that's not the only way to work mode S. If the satellite's antennas are aimed your way, and you can operate CW with two to four kW ERP, it's worth a try. Signals will be exceptionally weak, but usable. John Molnar WA3ETD described some excellent "Mode S Receive Techniques" in the May 1989 Hamsats issue. The 2.4 GHz WB5LUA preamps that John mentioned are now available from Down East Microwave, Box 2310 RR1, Troy, Maine 04987.

Mode L Upgrades

In the October 1988 Hamsats column, I described my Mode L uplink system. It included eight Watts through 65 feet of Belden 9913 coax to a single 45-element loop yagi. My returns were weak and SSB contacts few, but it worked.

I wanted to improve this. I replaced the feedline with Andrews ⅞" Heliax and added a solid-state amplifier from Down East Microwave. The 65 foot run of 9913 had about 3.5 dB loss at 1269 MHz while the Heliax showed less than one dB loss. My net gain was 2.5 dB. The mplifier provided 33 Watts output for eight Watts in. Net gain was just over 6 dB. The total 8.5 dB increase in ERP has made CW contacts easy, and SSB contacts reliable–most of the time. Since my local deed restrictions do not allow dishes or large uplink arrays, I needed more power for further improvements.

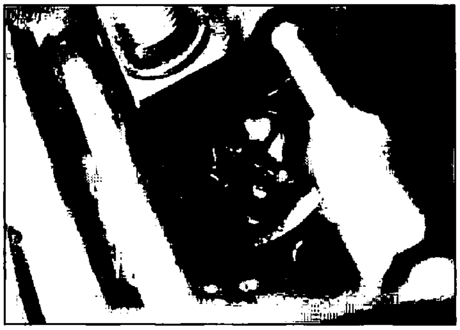


Photo C. Input and filament section of the Adler amplifier. Original LC network and resistor have been removed.

Back to Tubes

In the October 1987 issue of *73*, Pete Putman KT2B described a commercial tube-type power amplifier suitable for 1296 MHz. (*73* sells back issues if you don't have October 1987 in your collection.) If you have one of these Adler amplifiers, congratulations! They are hard to come by, but occasionally they show up at swap fests.

The article, "Everyman's Microwave Amp," explained some very simple modifications to the cavity-style unit which would provide nearly 100 Watts output for 10 Watts in. Performance is excellent in the high end of our 23 cm band, but it drops dramatically at lower frequencies. At 1269.5 MHz (the Mode L uplink) the output is less than the input. The following modifications, forcing the unit to tune lower, solve the problem.

The first step is to remove the shims used in the original modification to increase the output cavity's size. The reason for this is that the amount of shimming necessary to get to 1269.5 MHz will make it impossible to hook up the input connector.

There are two rods that position the cavity plunger when tuning the output section. They need to be about one-half inch shorter. Remove the mechanical tuning assembly and unscrew the plunger rods. They are threaded on one end and accept screws on the other. Carefully cut off one-half inch from each rod at the female end. Re-drill the screw holes and rethread for 6-32 screws. The shorter rods allow the cavity plunger to bottom out before the tuning assembly has reached its end. Install the shortened plunger rods, but do not put the mechanical unit back in place yet.

The input circuit was originally

Continued on page 70

Number 19 on your Feedback card

73 Review *by Gordon West WB6NOA*

Azimuth 100 Fluxgate Compass

Ideal for microwave hilltopping!

E&B Marine, 201 Meadow Rd., Edison NJ 08818
Tel: (800) 533–5007, Price Class: $369

Microwave hilltoppers understand the importance of knowing EXACTLY where they are. With their antennas positioned just a few degrees off, they will never be able to contact each other. For microwave work, you not only need your exact position, but also an ultra-accurate way to determine bearing (magnetic or true) to that distant station. How many times have you been hilltopping and discovered you really didn't know where you were, and had absolutely no way of figuring out where that dirt road was where you parked your car?

Enter Fluxgate

One of a new breed of portable Loran-C receivers, and a fluxgate digital compass (see photo), solve these problems instantly. This whole affair weighs less than three pounds, and runs nicely from a flexible solar panel! (See sidebar for an explanation of Loran-C).

How They Work

Hand-held and portable digital fluxgate compasses are the latest rage among mariners and pilots. These electronic compasses do not use a conventional floating magnetic card. Rather, they sample the Earth's magnetic field referenced to a tiny ferrite bar inside the electronic compass assembly. A built-in computer then analyzes the phase differences between the magnetic variations, and gives you a magnetic readout accurate to better than one degree! Mount this on your 10 GHz horn, or microwave dish antenna system, and there's no question about the magnetic or true bearing you have your system aimed at! The digital readout is easy to see at a distance, and it's rock steady. It's back-lit for night viewing, and the entire assembly only draws about 150 mA.

Easy System Powering

Your hilltop portable radio position determination station would start with a small 12 volt power source. I use a Yuasa gell-cell that gives me 12 volts at 6 ampere hours. This can run my NAV station the better part of a day. Hooked to that battery is a Sovonics "Sun Pal" Model 110 solar panel system. The panel

About Loran-C

"Loran" stands for LOng RAnge Navigation. Our country and coastal waters are blanketed by 100 kHz radio signals from US government megawatt stations. You can easily hear the transmitting characteristics of your local Loran-C stations by tuning your general coverage ham receiver down to 100 kHz. The signal sounds like the drone of an airplane.

Loran-C stations are usually set out in groups called "stars," with one master station set in the center of the star, and two or more secondary stations arranged around the master, as points on the star.

Refer to Figure 1. The curve of all points having the same *difference* in distance to a pair of stations is called a Line Of Position (LOP). The intersection of two or more LOPs, shown in the figure by dashed and dotted lines, fixes receiver position.

A master station broadcasts a series of nine pulses, coded so the receiver can identify it as the master. Secondary station S1 waits a precise interval, and then broadcasts eight pulses. The difference in the time of arrival of these two groups of pulses—TD1—at any Loran receiver in the area determines which LOP the receiver lies along, as shown in Figure 1.1

S2, after a longer delay than S1, broadcasts its own eight pulses. The difference in arrival time between the Master and S2 signals—TD2—locates the receiver along a second LOP oriented in a different direction, as shown in Figure 1.2. Figure 1.3 shows the intersection of the two LOP curves. The intersection point is the receiver "fix." In many current Loran receivers, a computer calculates the fix and reads your location in latitude and longitude, or in time delay numbers superimposed on marine and aeronautical navigational charts.

Each group of Loran stations is identified by its Group Repetition Interval (GRI). The GRI is a four-digit number that is entered by the navigator when you wish to manually select chains.

There are enough Loran-C chains throughout the United States to provide you with excellent Loran-C radiolocation capabilities. All you need is a simple receiver with base-loaded whip antenna.

A high quality Loran receiver will track the Loran signals with a random error of about 1/10th of 1 microsecond (0.0000001 second). The effect of this error of position accuracy depends on where the set is with respect to the Loran station it is receiving signals from. Signal tracking error generally causes short-term random position errors from one hundred to five hundred feet. Loran accuracy using latitude and longitude is usually better than one-quarter mile! Loran accuracy using charted TDs (Time Difference) is usually better than a few hundred feet. Position repeatability, using ground wave signals during daylight hours, is usually better than an incredible fifty feet!

Loran Users

Most Loran use is from commercial and recreational mariners that ply our coastal waterways. Many mariners are extremely untechnical, yet they adapt easily to calculating their location using Loran TD readouts and their local nautical chart. Aviation Loran receivers are now quite popular, and many pilots, as well as mariners, navigate from one point to another using the Loran's "waypoint" feature.

You simply key in the distant waypoint, and the Loran computer determines the line-of-sight bearing to that distant waypoint, either magnetic or true. Pilots and mariners head for that distant waypoint and let the Loran update them for their estimated time of arrival, their speed over land, and the amount of error off the desired heading course.

If you have questions on Loran-C, write or phone the Chief Aids to Navigation Branch, at the district office near you, or at *Loran-C Education and Information Project, US Coast Guard Headquarters (G-NRN/TP14), Washington DC 20593. Tel. (202) 472-5857.*

measures 18¼" x 12¼" x 3.3" when folded, and generates almost an amp of power on a clear, bright day. It's flexible and fits nicely in a backpack. It will actually run my ICOM 02AT full power out, on transmit, with no battery connected!

Loran Receivers

A Loran receiver draws approximately 1 amp at 12 volts DC. Loran receivers are easy to buy by mail order. All mail order marine electronic companies sell inexpensive Loran sets. (See address above.)

Don't spend more than $600 for a Loran set unless you have a boat or an airplane, and you plan to use all of the advanced waypoint features these more expensive sets offer. Many West Coast hams, getting into Loran for the first time, start out with the E&B "ASB 2001 Sea Ranger" Loran, a good performer. It comes with a base-loaded preamplified antenna assembly using coax as the feed. Simply screw any type of whip into the ⅜" twenty-four threads and you have a terrific antenna system. Even twenty feet of wire works well.

Good grounding techniques lower the 100 kHz noise floor and allow your unit to pick up more distant Loran chains. Experiment with the whip to come up with the best combination for a good signal. All Loran sets offer a signal-to-noise ratio display that allows you to play around with the antenna and ground connections. All indicators on a Loran unit are visual.

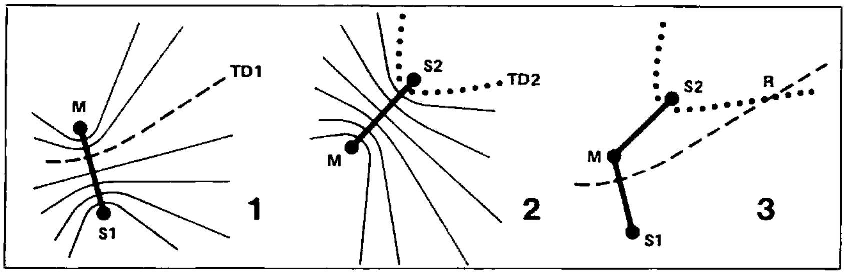


Figure 1. Diagrams of a Loran "star" group, that supplement the description in the sidebar.

The digital fluxgate compasses may also be hand-held, and they are available for approximately $125, manufactured by Autohelm (also found in the E&B catalog). I prefer a larger fluxgate compass, and I use the KVH Industries' Azimuth 100 compass that mounts directly on my 4-foot 10 GHz dish antenna setup. It has a memory function that also allows me to recall previous dish headings.

Portable and Fast

All of this equipment fits nicely in a backpack. You can trudge to the mountaintop with your hands free to carry the rig and your antenna assembly. It takes the typical Loran set approximately five minutes to acquire the signals, analyze the time delays, and begin reading out your position. Once the Loran set is locked onto your local chain, position updates take place several times a second. Your digital compass is an instant-on affair—turn it on, swing to the desired magnetic direction, and rest assured that that's the way to the other station!

Bring along some topographic charts. Find a marine or aeronautical chart with the printed Loran lines of position to further verify time delay readings. Calculate ahead of time the intersection of grid squares to find a hilltop that allows you to go from one grid to another.

The Loran system of today (Loran-C) is a dramatic improvement over the old Loran-A system of years ago. Loran is designated in the official navigational plan and is listed as one of the most accurate systems available for mariners, aviators, trackers, and hikers. There's no reason we shouldn't be using it, too, thanks to the low cost and availability of some very smart Loran sets and digital compasses. This gear will definitely give you a new "direction" on hilltopping. 73

HOMING IN

Radio Direction Finding

Joe Moell PE KØOV
PO Box 2508
Fullerton CA 92633

High-class T-Hunting

Come to the starting point of a transmitter hunt any weekend in southern California, and you'll see a line-up of eager contestants. Most of them have vans, trucks, or 4-wheel drive runabouts, with a beam or quad on a mast sticking up through a hole in the roof.

Active T-hunters are just like other hams who are serious about their special interests. We all know that serious DX chasers go to great pains to assemble their stations with state of the art rigs and ambitious antenna arrays. The contesters take care to lay out their equipment for efficient, easy-to-use operation. Likewise, successful T-hunters equip themselves with an array of well-functioning gear that gives reliable performance, set up to minimize errors and lost time in the heat of battle.

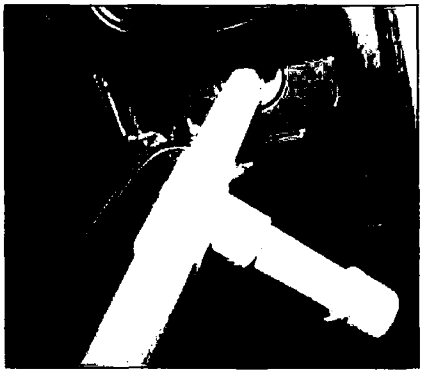


Photo C. The mast comes down through a trap door in the Astro roof console. The 4½-inch handle of PVC pipe allows lots of beam swinging without blisters.

Outfitting for Mobility

Our "All Day" hunts, held several times a year, are the ultimate test for DFers, who may spend all day and then all night looking for a hidden T that could be 200 or more air miles from the starting point. Many All-Day hunt devotees prefer 4-wheel drive vehicles, such as Broncos and Blazers for their mountain-goat traction. Others are partial to trucks, big or small, because of their power and ruggedness.

Trucks and 4X4s are nimble, but certainly not roomy. That's a problem for those who have lots of radios to mount and hunting gear to carry, especially if there are two or more persons on the team. More and more hunters are finding that a good solution to the space problem is a van. Full-size vans and minivans built on a truck chassis (such as the GM Astro and Safari) are plenty rugged. They take to the boonies well because of their high ground clearance. Be sure to get the nonslip differential, heavy duty electrical system, and extra large gas tank options!

When April WA6OPS and I got an 8-passenger van for T-hunting (we sometimes have lots of ride-alongs), it was easy to decide how to swing the various rotatable antennas. For us, a through-the-roof mount was the only way to go. The driver, the front-seat navigator, and even a mid-seat passenger can turn the mast. No one gets wet or cold reaching out an open window in the rain. There are no worries about getting ticketed for excessive antenna overhang. The 5 X 8½ foot roof provides a large enough platform for simultaneous operation of a Doppler DF and a quad.

Just like every ham shack, every hunter's setup is unique in some way. We carefully planned our T-hunt setup to meet our needs, but it would certainly work well for any active VHF T-hunter. Take a "systems approach" as you plan your own installation. Look at all the types of hunts you may want to tackle and all the equipment you may want to add. Then plan ahead.

Turning the Antenna

Once you set aside the natural reluctance to drill a big hole in your shiny rooftop, the rest is easy. The bushing (see Photo A) is two PVC plumbing fittings, a 1¼- to 1½-inch threaded reducer on top, and a 1¼-inch threaded-to-slip adapter screwed into it from the bottom through a 1-11/16-inch roof hole. Grind down any fillet on the shoulder of the lower piece so it seats properly.

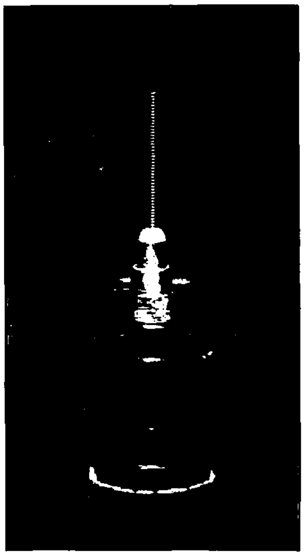


Photo A. When not in use for hunting, the roof hole bushing has a PVC cap. It makes a convenient mount for an extra whip antenna.

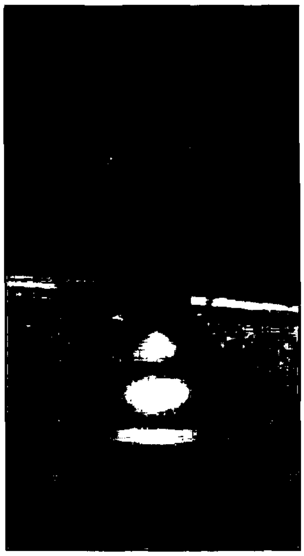


Photo B. It's not beautiful, but the plunger/rain deflector does the job, and you can move it from mast to mast.

PVC fittings have pipe threads, so they aren't designed to screw all the way into one another. You'll have to shave down the thread of the lower piece with a triangular file until it goes all the way into the top piece and the assembly doesn't rotate inside the roof hole. Don't force the fittings, or they'll crack.

Put some silicone seal around the roof hole and use a homemade gasket of tire patch rubber to waterproof the bushing installation. When not hunting, cover the hole with a 1½-inch pipe cap. You could mount an extra whip antenna on it, like the scanner antenna in the photo. When hunting, a bathroom plunger, which friction-fits on the antenna mast, keeps rain from running down inside (see Photo B).

Photo C shows the mast coming down into the van interior through the roof console. When you close the trap door after the hunt is over and the mast is removed, the bushing is out of sight. Unfortunately, the GM roof console includes a factory-installed corrugated steel support member that is difficult to drill through. It took a 2⅛-inch rotary hole saw and lots of patience.

Also visible in Photo C is an aircraft compass, mounted to the roof console and turned toward the driver at an exact 14.7 degree angle. That makes it easier to read, but more important, it automatically corrects for the magnetic declination in southern California. The canted compass indicates vehicle heading relative to true north instead of magnetic north, saving valuable plotting time.

The upper section of the antenna mast is ¾-inch Schedule 40 PVC pipe, slotted for exit of the coax where it joins the tee handle.

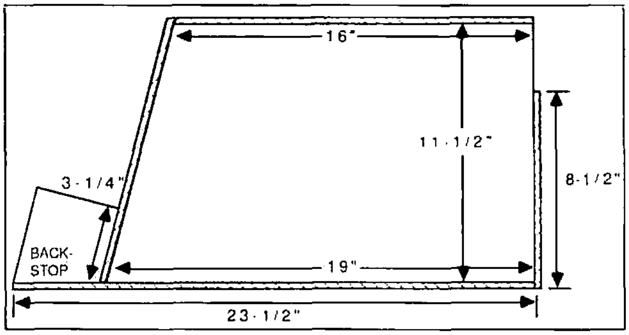


Figure 1. Driver's side view of the console box. Wood screws (#8 X 1½ inches) hold the top, bottom, back, and sloping front into the two trapezoidal pieces.

I have built several rotary antennas, including quads and yagis for various VHF bands, each with its own upper section. It's easy to take a piece of PVC pipe, cut it, slot it, and drill it to make an upper mast for any new experimental antenna.

The lower mast section, including the tee handle for easy turning, is used with all rotary antennas. It's made with thin wall (Class 125) ¾-inch PVC pipe with a broom handle inside for strength and rigidity. A pair of 8-32 X 2 inch bolts and wing nuts securely fasten the two mast sections together, making it easy to set up and take down. The rounded bottom end of the broom handle turns freely inside a cup made from a 1-inch PVC pipe cap and 1-inch slip fitting glued together with PVC glue. The receptacle mounts flush inside the console box (see Photo D).

For accurate bearings, there's a 360-degree protractor around the hole and a pointer on the mast. I cut the head off a size 8d box nail, mounted it into the electric drill chuck, and drove it into a 7/64-inch hole in the mast (pointed end out) for a tight fit. A small light bulb attached to the attenuator shines on the protractor for night hunting. To get a beam heading on the fly, read the pointer indication and the compass indication in degrees, then add them. Subtract 360 degrees if the result Is over 360. The result is a "true bearing," that is, a bearing relative to True North.

The Custom Console

I'm no woodworking expert, but the console box is simple enough to be within even my limited carpentry abilities. I made it from a single eight-foot plank of ⅝-inch thick particle board shelving, 11½ inches wide. There are two trapezoidal pieces, cut as shown in Figure 1 to form the left and right sides. The remainder of the plank is cut to form the top, bottom, back, and sloping front, all of which bolted into the edges of the side panels.

The rear panel goes only part way up, to give access to the interior. A heavy duty fabric belt holds just about any large or small transceiver securely in place on the front. Photo D shows 2 meter and 1¼ meter transceivers stacked. You can swap rigs for hunting on other bands in just seconds.

The console top holds important accessories, such as the attenuator and low-noise RF preamp, all of which use type BNC RF connectors for rapid reconfigurations. All items are secured with Velcro™ strips. Hidden behind the seat back in the photo are holsters for handi-talkies, made from plastic drink holders. There's even a charger to keep the HT batteries topped off. The inside of the console box has lots of room to store miscellaneous hunting necessities, such as protractor, compass, HT batteries, and maps.

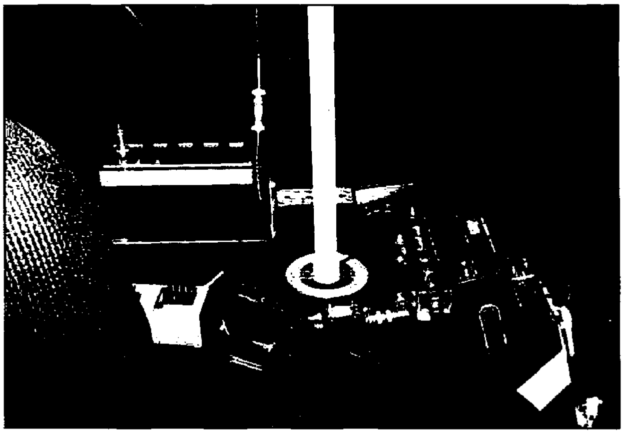


Photo D. The home-built console holds one or more transceivers of any size on its sloping front, along with the bearing indicator, attenuator, preamp, and HT battery charger.

I thought I'd have to bolt the console box to the floor or the seats to keep it from sliding around, but it hugs the carpet so well that it wasn't necessary. Not having to unbolt it makes it easy to move it out of the way for engine servicing. If yours slips, drive nails through the bottom board so that they protrude a quarter inch or so into the carpet.

Thanks to everyone who has written with their comments on "Homing In." I'm eager to hear more about your area's T-hunts. Next month we'll have a noise meter project for hunting very weak signals.

HAMSATS, Continued from page 64

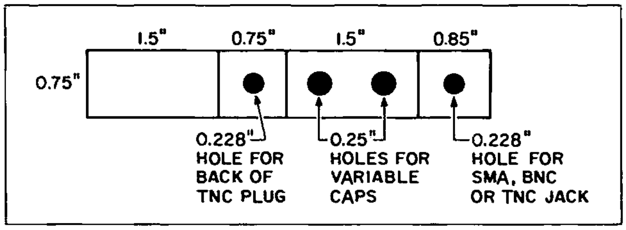


Figure 2. 1269 MHz amplifier input tuning box construction.

designed for frequencies above 1.3 GHz. This circuit will do fine at 1296, but it doesn't even come close at 1269.5 MHz. It includes a capacitor wrapped with a coil, and a resistor. Remove them and replace the capacitor/coil combination with a piece of wire. Be careful not to damage the socket assembly or the RFC chokes (the three to six loops of wire on the filament lines).

Reinstall the mechanical tuning assembly. The basic amplifier modifications are now complete.

Pete's article mentioned a "line stretcher" that he used to match the 50Ω output of his exciter to the tube's input. If you have one of these, you are ready for microwave DX via satellite. If you don't, here are instructions for a simple matching network which can be built with only a few parts.

Constructing a Matching Network

Photo A shows an input matcher mounted via the TNC jack on the amplifier. Photo B shows its internal wiring, while Figures 1 and 2 define construction dimensions and parts placement. The design was derived from the 1.2 GHz amplifier project in *The ARRL Handbook*.

When using a strong 3CX100A5 or 2C39WA, output will be between 70 and 80 Watts. The output cavity is at its maximum possible dimension with no room for further tweaking. This precludes any operation in the lowest portion of the 23 cm band, but this cost-effective amplifier can add several dB to your uplink signal and provide easy SSB and CW contacts in all situations. Remember to tune it first at low power levels.

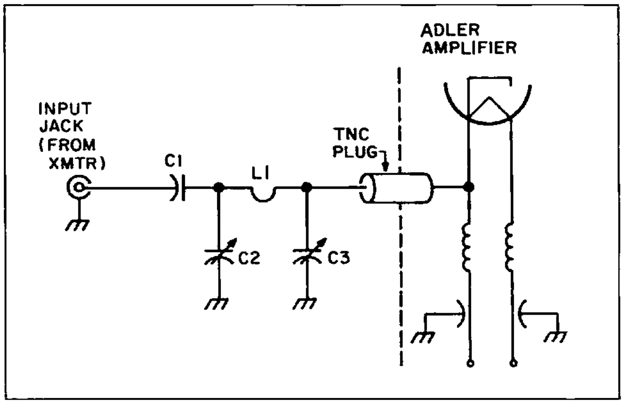


Figure 3. Schematic of modified 1269 MHz input network.

Dish Notes

For those of you who can install a dish antenna without antagonizing anyone, the "Inexpensive Mode-L Dish Antenna,"an article by Keith Berglund WB5ZDP in the May 1989 issue of *73* can provide a fast way to a better uplink.

When building the dish from the article, note that Figure 2 of that article on page 18 calls for a one-inch floor flange on both sides of the antenna hub. The flange going to the feed assembly should be 0.75 inch or even 0.5 inch. It doesn't take much to support the can-type feedhorn.

The feedhorn drawing in Figure 4 of Keith's article does not show the distance from the back of the can to the center of the N-type panel connectors. Set this distance to 3.2 inches. Refer to the cover photo of the May issue for feedhorn mounting details and enjoy a fine home-brew dish antenna.

ABOVE AND BEYOND

VHF and UHF Operation

Chuck Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake
San Diego CA 92119

Coaxial Connectors

There are many different types of connectors in use today for amateur applications, plus various military and space applications. Hams use different frequency spectrums, so they need several types of connectors. Choosing the correct connector can be confusing.

PL-259 (UHF)

The most common type of connector used today is the UHF or PL-259 connector, intended for larger cables such as RG-8. You will find it on high frequency transceivers, and on a lot of the VHF/UHF commercial transceivers in production. This connector was used in a lot of military equipment until it was dropped during the early 1960s. It's still used in amateur radio equipment, mainly because it's relatively inexpensive: about $1 each for the chassis or cable connector.

The UHF connector is not weatherproof and does not exhibit a normalized impedance through the connector. By "normalized impedance," I mean that the ratio of the inner pin to the outer shell size is constant and conforms to a standard design impedance, producing a low SWR through the connector. At frequencies up to about 200 MHz this is of little concern, if you're not fussy. You can use it at slightly higher frequencies, but I don't recommend this. The maximum peak voltage rating for the UHF connector is 500 volts.

You can use the UHF connector with RG-58 and RG-59 cables if you screw an adapter for the smaller coaxial cables into the rear of the PL-259. Without this adapter, the PL-259 (UHF) connector must be used with RG-8 cables directly. The UHF connector is a versatile connector, but keep in mind that it is not a good performer at VHF/UHF frequencies. It's ironic that it's called a UHF connector but really can't be used there! The UHF connector goes in the same category as the RCA phono and similar connectors: They connect cable ends together but give attention to little else. At high frequencies (30 MHz) this is just a small problem, but at 300 to 500 MHz the UHF connector's performance is marginal.

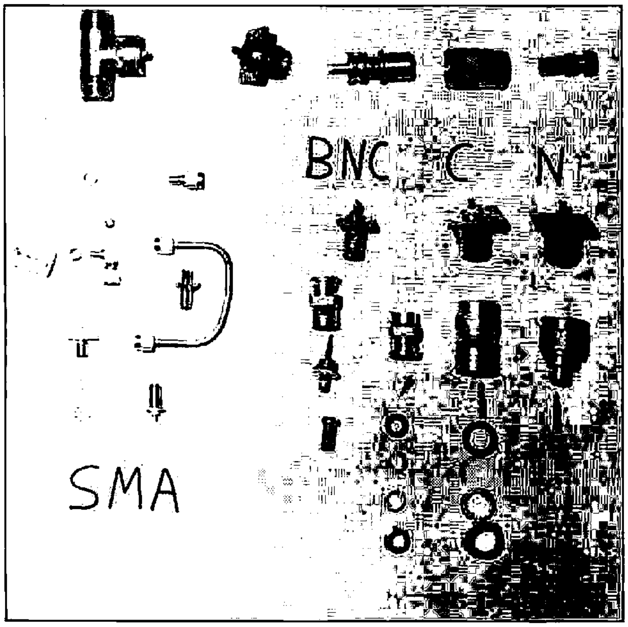


Photo A. Connectors. Across the top are the UHF PL-259 connectors. The small cable adapter is at the far right top. The N connector is a crimp on type, while the C connector is an older style, manually-assembled connector. The right BNC connector is a manual assembly, while the left BNC is a crimp type.

The SMA connectors are on the left. They are shown with the other connectors to compare size. The table gives additional information on some of the most used connectors.

BNC/TNC

The next most widely used connector in amateur applications is the BNC connector, most familiar on 2 meter HTs. This connector is one of the early designs that's good to 10,000 MHz. Currently, it's not really used above 3 GHz in most applications, but this is due to operator preference rather than to connector limitations. The BNC connector shields the inner conductor well, using beryllium copper fingers that make good contact between the mating connector shields. This advantage, combined with its quick-disconnect snap-on twist operation, makes the BNC a very good connector.

The BNC is rated for a standard impedance of 50Ω and 500 RMS volts peak.

There is also a screw-in type that is very similar to the BNC, called TNC for "threaded type of connector," that is useful where there's high vibration. The BNC and its cousin the TNC are identical in almost all respects, keeping in mind that the BNC is twist-on and the TNC is threaded on. (The BNC and the TNC will not mate with each other). Most of the military surplus equipment available has BNC, rather than TNC, fittings.

The BNC type of connectors make up the bulk of medium coaxial cable connectors in amateur use. BNC connectors are used on RG-58 (50Ω), RG-59 (75Ω), and similar size cables. Loss factors on either of the two cables aren't very good on frequencies above 50 MHz. I use the BNC connectors at 10 GHz but adapt them to use 0.141″ hardline or semi-rigid coax to keep loss very low. Most applications with RG-58 or 59 is restricted to short lengths of cable where cable loss is not too important. Short runs in mobile applications are where these cables shine as they can be routed in small channels to hide the cable run.

Type N/Type C

A very popular connector favored by the UHF operator is the type "N" connector. The type N connector is truly a weatherproof connector and may be used outside. (Weatherproof or not, it's a good idea to wrap outside connections with a layer of rubber tape, and cover them with a layer of good electrical tape.) The N connector features a high peak voltage rating of 1500 volts and provides a true constant impedance through the connector.

The N connector is a threaded connector and is intended for use with larger cables like RG-8. There is a type "C" connector which is identical in all respects to the N connector, except that it is a twist snap-on. The C connector is made for the larger coax cables like RG-8. Both the N and C versions are weatherproof and are specified to 12.4 GHz. The two types are equal in performance, but the type N has found its way into more equipment and is far more popular than the type C. The type N is found on a lot of commercial test equipment, attesting to its excellent use at microwave frequencies. N and C connectors cost new about $4–7 each; the chassis mating connector is $2.75. The N connector is easily available in the surplus market and at swap meets.

Please note that with these connectors you can specify a type N connector in either 50Ω or 75Ω. (There is no such specification with the PL-259 connector; one size fits all types.) This can cause a problem if you're buying surplus parts: The 50Ω N connectors will not mate with the 75Ω N connectors. You won't see the difference at first glance, but look closer. The 50Ω connectors have a slightly larger center pin diameter than the 75Ω N connector. Look carefully and be sure of what you have!

I have more equipment in my ham shack that uses the N connector than I can count. Almost all test equipment has the 50Ω connector (unless it's intended for the TV industry, which specifies 75Ω).

Almost all of the projects in recent publications using larger connectors have selected the type N connector. This popularity stems from the constant impedance and applications with larger low loss coaxial cables in use at frequencies from 450 MHz and up. The N connector really shines in use with preamplifiers and such. Most of the newer GaAsFET designs have been shown using the N type connector in frequencies below 5 GHz.

N connectors cost more, but they're worth it. When you are

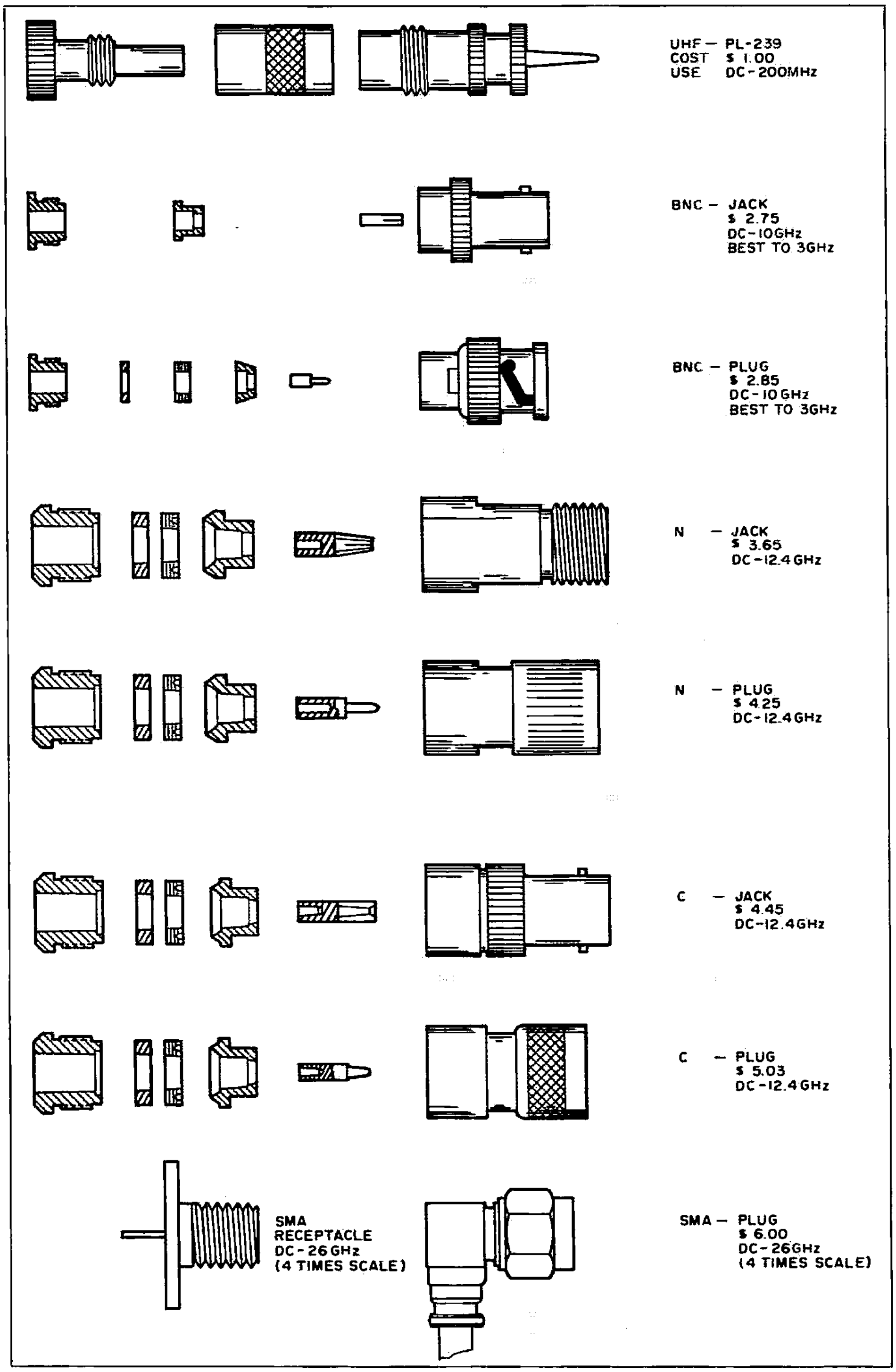


Figure 1. Comparison of popular cable connectors.

setting up equipment to do weak signal work on frequencies of 220 MHz and up, you will appreciate using a connector that gives constant impedance and low loss, with minimum SWR through each connection.

SMA Type

Fourth in popularity is the small miniature SMA connector. By "miniature," I mean a connector that is smaller than the BNC, which is classified as medium. The SMA connectors are coming of age in amateur circles. Industry-wide, the switch to miniature connectors took place quite some time ago. The SMA connector is rated from DC to 26 GHz, making it quite versatile in its application. Additionally, this connector provides a constant impedance through the coaxial connection. I favor the SMA connector and use it in most of the projects on my workbench. Since it's miniature, the SMA can't be used for very high power applications. Limit its use to 50 Watts at the higher microwave frequencies.

This connector shines in small receiving preamplifier and filter applications. Without a connector that will give constant Impedance through its connection, you would get an impedance bump causing SWR discontinuity. This discontinuity is very pronounced at microwave frequencies because the size of the connector begins to become a sizable fraction of a wavelength. The SMC connector is quite small, less than ¼ inch in diameter, and is intended for use with miniature coaxial cables as well as with miniature rigid-type cables.

"Consider that most amateurs keep a feedline and antenna system ten years or more . . . Spend a little extra and your connectors and feedline won't let you down."

Most microwave applications specify use with rigid coaxial cables because loss is minimal when using short lengths: You are not concerned with 10 inches or 10 feet of cable at 30 MHz as loss is relatively unimportant in such a short length. As you increase frequency, the length and distributed capacitance and other factors also increase the loss of the cable. For instance, at 10,000 MHz (10 GHz) a 10-inch piece of braided Teflon™ cable showed a loss of 10 dB.

Replacing the braided Teflon cable (using SMA connectors) with a 10-inch piece of semi-rigid (hardline) cable 0.141 inches in diameter reduced the loss to something under 0.3 dB. You wouldn't use this type of cable to make long runs at microwave frequencies, but it's ideal for tying all parts of our microwave projects together. The heavy use of the SMA connector in both industry and with the microwave amateur make this SMA connector very versatile indeed.

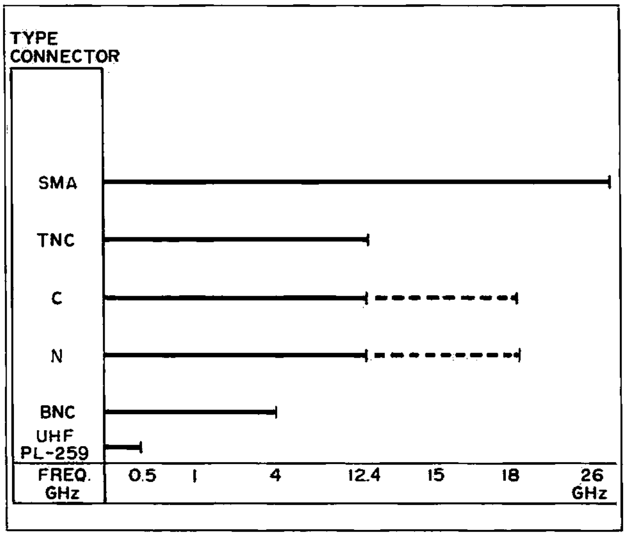


Figure 2. Bargraph of effective frequency limits for popular connectors.

Coaxial Cables

The "Coaxial Cable Loss: Quality Comparisons" table shows the commonly used coaxial cables and provides some loss figures comparing the various types. These coaxial cables are what is normally stocked at amateur retailer stores. For the microwave frequencies, the cables used are mostly a variety of the RG-8U types. I have used several pieces of RG-9BU, which is very similar to RG-8, except that it is a double-shielded braid. This makes it more difficult to assemble the connectors, but the effort is worth it. The double shield allows less leakage than its single-braided counterparts. I did not find RG-9 available from retailers so I did not list it. RG-213 is useful at frequencies up to 10 GHz in short lengths to connect test equipment together. I think most of us have obtained similar cables in microwave test sets from surplus deals.

At frequencies above 1 GHz you should try to minimize feedline loss. One method to lower feedline loss is to mount the equipment near the antenna so that the IF signals at a lower frequency will be cabled to the operating position, allowing you to locate the microwave transmitter and receiver at the antenna.

This is by no means a complete list of cables and connectors—the list was prepared to give you some idea of what is available. As you can see, the loss factors in comparison to the #318 Heliax™ cable look dismal at best. The cost is high, but it's well worth it. That's why most commercial installations use Heliax for the very low loss. Remember that three dB of loss means that one-half of your power into the cable is absorbed by the cable. That means that if you select RG-174 and use a 100-foot length at 30 MHz, you will have a 6 dB loss with a transmitter that has 50 Watts output. The antenna will receive 12.5 Watts on the other end of the coax.

That's just one reason why 9913 costs 50¢ more a foot than RG-174. The 9913 is a poor man's Heliax cable, and cost versus performance is very good. The 9913 is a very good cable. It will never be equal to a true Heliax cable like 318, but the price difference makes up for that.

Beware of bargain priced cables and connectors. Many of these "No Name" connectors are junk! They don't solder well, and the center insulation of the PL-259 melts when you solder the braid. You can recognize them by the very shiny, almost plastic, finish and by the "No Name" printed on them. The good ones are all stamped with identifying companies' names and types.

Even if price is your only objective, consider that most amateurs keep a feedline and antenna system ten years or more, Spend a little extra and your connectors and feedline won't let you down!

Hodgepodge

The Ventura Amateur Radio Club was presented with a 50-year affiliation certificate from ARRL section manager Tom Geiger. Congratulations for 50 years of club activity! The club is presently putting together plans for a group 10 GHz construction project.

The *QST* "New Frontier" column in March 1989 described two 10 GHz Gunn oscillators connected through a "Magic T" to lock the two oscillators to each other, providing more output than the two oscillators combined normally do. I tried it, and my spectrum analyzer display went nuts. I tried this after Kent WA5VJB stated that he'd had the same result. The oscillators locked over a very narrow adjustment, but did not obtain the higher power output. On a spectrum analyzer, the output looked very dirty. Is there anyone that has made this work? Possibly Kent and I have done something wrong. All this in the pursuit of 10 GHz power!

The North Texas Microwave Society is hosting the 1989 Microwave conference. Ever since its conception in 1985 by Don Hilliard W0PW, it has been held in the Estes Park, Colorado area. Don is taking a break and has allowed the North Texas Microwave Group to move the conference south for a year. This year the conference will be held at the Flagship Inn in Arlington, Texas, October 5, 6, 7 and 8th. October 9th is Columbus Day and may be a holiday for some of you. The location is very near the site where the 1987 Central States VHF Society Conference was held. The ARRL has again agreed to publish the proceedings.

The Flagship Inn is located half way between Dallas and Ft. Worth, minutes away from the DFW airport, and very near "Six Flags Over Texas." Room rates are $50 per night, and a block of rooms has been reserved. Technical sessions will take place both Friday and Saturday. There will be swapfests, noise figure contests, and a surplus tour of the area. These are only part of the events planned in addition to the series of technical sessions. Contact Al Ward WB5LUA at (214) 542-6817, or Wes Atchison WA5TKU at (817) 482-3914 for information. ■

Coaxial Cable Loss: Quality Comparisons

TYPE RG#	8U	8X	58A	59B	174	213	214	9913	318	½	½
OHMS	52	C52	52	75	50	50	50	52	50	50	75
DIA IN.	0.405	0.305	0.405	0.242	0.100	0.405	0.405		1.25	0.6	0.63
MAX KV.	4	4	5	2.3	1.5	5	5	3	10	5	5
LOSS dB/100 FT.											
30MHz	0.9	1.3	2.6	2.5	6.0	1.2	1.2	0.5	0.1	0.3	0.4
150 MHz	2.0	3.2	7.0	4.5	NR	3.0	3.0	1.5	0.35	1.0	1.3
450 MHz	3.5	8.0	NR	7.0	NR	5.8	5.8	2.9	0.80	2.0	2.5
1 GHz	6.0		NR	NR	NR	10	10	4.8	1.2	2.5	3.4
5 GHz	NR		NR	NR	NR	NR	NR	NR	3.2		
COST/FT.			0.35	0.14	0.10		1.55				
HRO	0.59	0.39				0.69		0.69			
TEXAS T		0.22				0.36			4.95	0.79	
AES	0.47					0.69		0.64			

NR= Not Recommended

Suppliers:

Ham Radio Outlet	Texas Towers	Amateur Electronic Supply
5375 Kearny Villa Rd.	1108 Summit Ave. Ste.#4	4828 W. Fond du Lac
San Diego CA 92123	Plano TX 75074	Milwaukee WI 53216
	(214) 442-7306	(414) 442-4200

Number 26 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free, on a space available basis. Please type or neatly print your request on a full-size sheet of paper. Use upper and lower case letter—not all capitals. Be sure to print numbers carefully. A "1" and "l"; "7" and "T" or "I" and other numbers and letters can be easily misread when they are not printed clearly. "U" and "V" can also be confused. Thank you for your cooperation.

I have two FAX machines I'd like to put to use. They are Qwip model 1000 and model 1200. I need a manual, schematic, paper type, and source. Thanks for any help.

Chuck Pound
207 West Street
Mineral Point WI 53565

I am looking for anyone who has modified a Heath HW-101 in any way. I am especially interested in solid-state substitutes for tubes within the rig. I will pay for any photocopying and mailing costs.

Jack Burris DA2UI/NZ0C
C Co 1/54 Inf
Box 22998
APO NY 09139

I need manual or instructions for the California Computer System model 7470 BCD A/D converter card for the Apple II computer. Will pay copying and mailing charges.

Waldo Orgnero
Box 32 Site 7 SS 1
Calgary AB CANADA T2M 4N3

Wanted: Information on modification of Dentron "Clipperton L" to operate on 10 meters. Thanks.

Larry Sellars KB5EIU
104 Dennis St.
Lake City AR 72437

Need the SERVICEMAN'S Manual, showing BOARD LAYOUTS for Icom IC-22S. Will pay postage and copying costs.

Timothy P. Brown KA8CIZ
2264 Buxton Avenue
Cincinnati OH 45212

Where can I obtain the 4 x 1K RAM chip type HM-3-6504-9 manufactured by Harris and used in the CMOS super keyer in the 1988 ARRL *Handbook*?

Lionel L. Sharp VK4NS
19 Kelso Street
Chermside, Brisbane
Queensland 4032
Australia

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

Esperanto. *Let's see how bright we all are. We are told that there are four regional representatives for those interested in the International League of Amateur Radio Esperantists, the one for you to contact depending upon where you live. Ready? "Regionaj reprezentoj: **Nordameriko**—W2CIL E. Lindberg, 113 Maple Drive, NY 14026 Bowmansville, Usono; **Sudameriko**—PT2CA E. Alves Silva, Caixo Postal 04-0144, BR-70000 Braslia (DF) Brazilo; **Azio-Pacifico**—JR1ISG K. Nakazima, Simoongatamati 725, 192-01 Hatiôzi-si, Japanujo; **Europo**—DJ4PG H. Welling, Bahnhofstr. 22, 3201 Hoheneggelsen, Germanujo."*

Additionally, there is the Esperanto-DX-Club and its publication, DX-Informilo. *Contact Günter Conrad, Kafkastr. 48/5M, D-8000 München 83, FR Germanujo.*

European Community. The other day we were asked who belonged to the EC—the "United States of Europe," as some have called it—which is due to put 12 nations under one economic roof (among other standardizations in the social field), by the end of 1992. They are, in alphabetic order, Belgium, Britain, Denmark, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and West Germany. Compared to, say, the United States, the population of the EC will be larger—322 million as against 242 million. As standardization of communications is one part of the planning, we will report such information as comes, relative to that.

At the moment, we have this bulletin: *FLASH!:* There will continue to be at least three *different* kinds of electric plugs used in the EC. A study found it would cost as much as US$80 billion to insist on one type only!

Roundup

Australia. 5Z4BH tells us that a DOC brochure written for foreign hams wishing to operate in Australia recommends they avail themselves of over-the-counter service instead of applying ahead of time. Visiting Sydney, that's what he did, and: "I had my two-meter handy-talky with me and was on the air and immediately made welcome by the 2-meter repeater bunch even before I was out of the DOC building." (See his full report under the Kenya flag, below.)

South Africa. Peter Strauss ZS6ET writes that life is hectic for him. "I will be in Taipei [Taiwan] from June 6th to 25th June, 1989, on business, but also hope to meet again OM Tim Chen. In the meantime I have been appointed as the IARU co-ordinator for South Africa by the 'Interim Management Committee' of SARL."

Reporting In the South African Radio League *Bulletin*, Peter writes: Following the acceptance by a large majority. . . the Headquarters of the South African Radio League [will move] from Cape Town to the PWV area [Johannesburg]. . . *This will bring a lot of SARL HQ activity!—Peter.*

New ZS3UN call suffix now available!: In response to a proposal from the SARL, the licencing authority in Windhoek, SWA/Namibia have introduced a new callsign prefix on application available to radio amateurs in South West Africa who are members of UNTAG. The foreign amateur's home callsign will follow the prefix ZS3UN/. . .

The United Nations Transitional Assistance Group (UNTAG) consists of a team from Australia, Great Britain and other nations. This group will supervise the transition of the territory to independence in terms of UN resolution 435 and is expected to stay for at least 12 months. Previously licence facilities have been limited to permits valid up to 3 months unless the visitor arrived from a country with which a bilateral agreement had been concluded. Now radio amateurs of the UNTAG group holding a valid CEPT class I or CEPT class II compatible licence may operate while in the ZS3 call area.

Applications should be addressed to: The Postmaster General, (Radio Section), PO Box 287, Windhoek 9000, South West Africa/Namibia.

Two repeaters for 2 metre mobile operation are currently operational and a digipeater is planned for installation during 1989 in the territory. *I know of no other administration to introduce facilities for "visiting" UN forces so quickly! A big Rah Rah Rah to the chaps in the licence authority in Windhoek!—Peter.*

[Remember that the following was written April 2.] Amateur Radio operation from Marion Island will soon be causing pile-ups when ZS8MI becomes active again. The Island was last heard on the air 10 years ago when Johan Jordaan ZS6BEE spent 14 months there. This week Peter Sykora ZS6PT left on the supply ship and is expected to arrive some time today. Within a few days he will be active using the new callsign ZS8MI. Besides HF he will also be operating on 6 metres and on Packet Radio. The QSL address is PO Box 1387, Van der Bijl Park 1900, or to ZS6PT via the SARL QSL bureau. *The old callsign was ZS2MI!—Peter.*

KENYA

Rod Hallen 5Z4BH
Box 55
APO New York 09675

Report from East Africa

This has certainly been an exciting year so far! Just before it

Calendar for July

1—Canada Day; National Day, Burundi and Rwanda (5th for Cape Verde, 6th for Malawi)
4—Philippine American Friendship Day; Independence Day, USA (5th for Venezuela, 9th for Argentina, 10th for Bahamas, 20th for Colombia, 26th for Liberia, 28th for Peru)
12—Orangemans Day, Northern Ireland
14—Bastille Day, France
17—Constitution Day, Korea; National Holiday, Iraq (21st for Belgium)
18—Liberation Day, Nicaragua
19—Martyrs' Day, Burma
22—National Liberation Day, Poland
23—Revolution Anniversary, Egypt
24—Simon Bolivar's Birthday, Latin America
25—St. James Patron Saint, Spain
26—National Rebellion Day, Cuba
31—Revolution Day, Congo

ZS To F Packet Contact

26 Mar 89 06:05:46 Z From: ZS6CE and ZS6SAT—To: ALL and ZS6IT—Subject: FM SIXMETER PACKET FIRST "ZS"!

HI THIS IS ETIENNE, KG 34 RANBURG DISTRICT [NEAR JOHANNESBURG]
ON 25 MARCH 1989, ZS6CE MADE THE FIRST SIXMETER DX FM PACKET CONNECT 1200 BAUD
THE TIME WAS 1732 LOCAL TIME.
THE FREQ 50.400 FM!!!
THE STATION F6FEF JN06 FRANCE.
CONDITIONS WERE FAIRLY GOOD ON SIX!!
THE AVERAGE RETRY WAS 4 WHICH WAS GOOD, BEARING IN MIND THAT IT WAS FM DX ON VHF.
RST SENT 579 RECEIVED WAS 559.
AT 1732 OM ERROL IN KG 33 CONNECTED TO F6FEF. RST GIVEN UNKNOWN RST GIVEN 579. [?]
ZR6KE THEN DIDGI THRU ZS6CE RST RX'D WAS 599 AGN...
ALL CONTACTS WERE SUCCESSFULL.
F6FEF (MIKE) THEN WENT ON TO WORK ZR6KE-1 PBBS AND SUCCESSFULLY LEFT A MSG.
A BEACON WAS ALSO SENT VIA ZS6CE AND WAS HEARD FAIRLY WELL AT ZS6CE QTH.
WELL ANOTHER FIRST FOR ZS PACKET
F6FEF FADED OUT 1h45 MIN AFTER THE 1ST CONNECT.
WELL DONE TO ALL HI..
P.S.
•••••••••••••••••••••••••••••••••••••
F6FEF READ A CQ SENT BY ZS6CE and ZS6SAT
•••••••••••••••••••••••••••••••••••••
73 ETIENNE PACKETNUT ALL MODES DIGI de ZS6ET

began, I became QRV on RTTY with my Compaq Deskpro 286, AEA PK-232, Kenwood TS-430S, and CushCraft A-3. I've been making contacts as fast as I can type, ever since. That is, when I'm here! Starting in mid-January, my XYL and I spent five weeks on R&R in Sydney, Australia, which is her home town.

My VK1HR license had expired a few years ago, and I was hopeful that it was still available and could renew it. I shouldn't have worried: The whole process took less than 20 minutes and cost A$30 (about US$27) for one year.

Now that is true over-the-counter service. In fact, the DOC recommends in a brochure written for foreign hams that they avail themselves of this service instead of applying for an operating permit in advance. I was on the air with my 2-meter handy-talky before leaving the building. They tell me there are 90 2-meter repeaters in VK land.

Before departing Nairobi, I was lucky enough to become acquainted with Pat VK1RZ on the 15-meter Australia—New Zealand—Africa (ANZA) net, which meets every day at 0500Z on 21,205 MHz. Both Pat and John VK2MUV were very gracious hosts during my visit to Australia, providing me with a super station to operate from, and also organizing a Ham Bar-B-Que in my honor. Just before leaving Nairobi I blew the finals in the TS-430S (too much RTTY keydown timeII), so I took it along and had it repaired by Kenwood Australia.

As luck would have it, the Central Coast Amateur Radio Association was having its annual Field Day near Sydney. (In the States, we'd call this a Hamfest with dealer displays, contests, seminars, and a large flea market.) I was told this was the largest Ham gathering in Australia ever, with over 1200 in attendance. I attended a seminar on Packet radio networking which was way over my head, but I'm sure interested. Would you believe I didn't win the prize for traveling the farthest even though I came 8,000 miles!?

I was back home again only long enough to warm up the rig to make sure it was operating properly before I was off again - to Burundi (9U5) and Rwanda (9X5). No activity in the former but I did spend a lot of time in the shack of Jon 9X5AA. He is a CW operator primarily, so I did my part by giving out quite a few hundred SSB contacts on 10 and 15 meters.

Jon and I are planning a DXpedition to 9U5. We haven't set a specific date yet, but it will be either late Spring or Summer, and before Jon leaves Kigali this Fall for a new posting in Capetown. No trouble with a license and we have plenty of equipment, but a big problem will be a good portable antenna. We've even picked out a location on the shore of Lake Tanganyika. The Comoros Islands (D68) looks like a very good possibility for a DXpedition, also.

My biggest dream is to operate from either 9X5, 9U5, or some other exotic East African location on RTTY, but first I'll need a portable computer to travel with. I'm considering the Toshiba T-1000 or the Sharp 4502, but I may have to wait for my home leave next year before I can get one. The AEA PK-232 is a fantastic piece of equipment, especially with the PC-Packrat software, and easy enough to travel with. I will be here for the next two and a half years, and even when Jon leaves Kigali, I hope I will be able to operate 9X5AA from time to time.

I've written a logging program running under dBASE III Plus that makes logging and searching for past contacts immensely easy. I'm modifying it now so that it will automatically give me DXCC, WAS, WPX, and other reports. Once a month I send an up-to-date floppy diskette with my log on it to Bill KE3A, my QSL manager, and he runs it on his computer. I certainly appreciate this! I wouldn't have nearly as much time to operate if I had to spend time slaving over piles of QSLs.

RSK, the Radio Society of Kenya, is still very active. Total membership now stands at 110. The 2-meter repeater is being moved to a better location and a 70-cm repeater is in the works. The club station, 5Z4RS, is being renovated to encourage more members to use it.

If you're interested in the Kenyan Award, ten points are required. Contact with any RSK member counts 2, and with 5Z4RS counts 5. Send a certified list of contacts, a large SAE, and $5 or 5 IRCs (not 10 as stated in the 1987 ARRL Operating Manual) to the RSA, PO Box 45681, Nairobi, Kenya.

Good news: It appears Kenya will have a Novice licensing regulation in effect this year! This should help swell the ranks of 5Z4 amateurs. RSK will be doing its part.

USSR

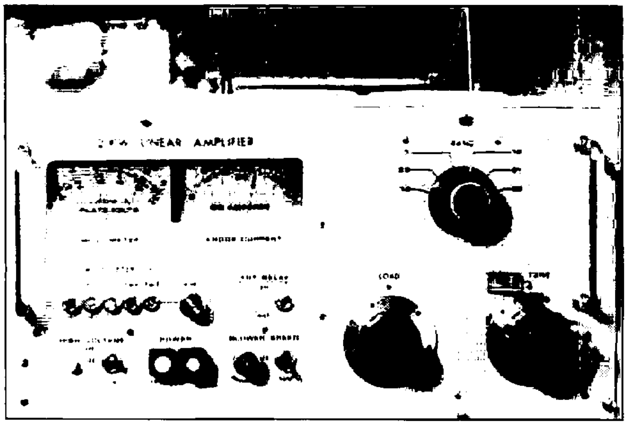
From Mike F. Shakirov UA9MI
PO Box 2056
Omsk 644119, USSR
via Ken Carpenter KC4UG,
PO Box 586
Vernon, AL 35592

[Faster than we could say to KC4UG, "maybe he [meaning UA3MI] can send replacements?"—which is what we did say in the May issue—he did! And Ken has passed them on to us. Ken notes that on the back of the amplifier photo it says that it has "equal performance with the Alpha 77D."—CCC]

Dear Ken—Thanks for your letter and the news from Vernon and USA. I am very sorry that my letter was opened and two pictures missing. I am enclosing duplicates, please send them to *73 Magazine*.

I said hello to [Hambassador] UA9MA and the gang in Omsk for you—no problem. I have only one daughter so far. My age is 41. Ken, your plans to visit the USSR is very good. I also have a dream to visit the USA, but the demands of my jobs will make it very difficult.

Best wishes, dear Ken, to all your family, also to the ham radio gang in Vernon.



The UA9MI home-designed and brewed linear amplifier.

The station of UA9MI.

continued from p. 63

point of attachment for the Hustler resonator.

Two Out of Three Isn't Bad

With that done, it was time for a trial. I installed the now 7.5 foot mast on the mast spring mounted atop the ball mount. I attached two lengths of fishing line to the top of the mast to serve as guys. Then I installed a resonator spring atop the mast, followed by a 75 meter resonator.

No doubt about it, it was a tall mobile antenna. Would this contraption resonate on the 75 meter band with more or less the same resonator whip length? Would it make any difference? And third, would it work on any of the other bands?

After all the guesstimating I had done, I must admit that I was somewhat surprised when I put some RF into the extended Hustler and found the point of minimum SWR nearly on the same frequency as it was with the standard Hustler.

Despite that initial success, I had some doubts as to whether the modification would actually result in any noticeable difference in signal strength. Transmitting with constant power into each antenna, both resonated to the same frequency, there was a consistent 2 dB advantage for the longer antenna at a receiving site ¾ mile away. I didn't get the 3 dB I had hoped for, but 2 dB still seemed to be a worthwhile gain.

I then tried the extended mast with a 40 meter resonator in place of the 75 meter unit. It also provided a low SWR with only a slight change in resonator whip length. The gain on 40 meters with the longer antenna was again 2 dB. Down came the 40 meter resonator and up went the one for 20 meters. After shortening the resonator whip length approximately 2 inches, the 11-foot antenna was ready for action on the 14 MHz band. Gain was again 2 dB.

Increased bandwidth was an additional benefit of the longer antenna. While there was minimal difference between the two antennas on 75 meters, on 40 meters the 2:1 SWR bandwidth increased from 49 kHz to 75 kHz. On 20 meters, it went from 235 kHz to 370 kHz when I changed from the standard Hustler to the extended version.

The final question is: Is it worth it? You have to answer that one. On many transceivers today, 2 dB is typically no more than half an S-unit. Eleven feet of antenna is a lot of mobile antenna for 2 dB. On the other hand, decibels have a tendency to add up, and you should notice a substantial improvement if you change your mobile antenna from a standard Hustler antenna, bumper-mounted, to the extended version mounted as high as you dare on the vehicle. (By my best estimates, an extended version mounted on the bumper would probably be indistinguishable in terms of signal strength from the stock antenna mounted high on the vehicle.)

Also, by changing the length of the extension, and hence the position of the resonator coil, it may be possible to squeeze another dB out of the longer antenna. There is room to experiment in this regard, particularly if you wish to optimize the antenna for one particular band.

GW-BASIC Program News

A BASIC program for estimating antenna gain for VHF/UHF operation appeared in this column in the April 1989 issue. It was written in GW-BASIC for IBM compatibles. Two readers were kind enough to send in their versions of the program, modified for different versions of BASIC. Chuck Bates W6JWX provided a version for the Commodore C-64. Chuck will copy it to your 5-¼" disk if you send it in a re-usable mailer along with a return label and return postage. His address is *Chuck Bates W6JWX, 1637 Lang Avenue, West Covina, California 91790.* Another version, for the TRS-80, CoCo 3, was provided by *Lisle Hines K2QLA, 11 Meadow Drive, Homer, New York 13077.* You may obtain a printed copy of either version of the program by writing me. *(Please enclose an SASE with your request—Ed.)*

One final comment on the VHF/UHF program. I received several letters regarding the original program listing. Unfortunately, several errors appeared in the program after it left my desk. Specifically, they are:

—The at signs ("@") right after the program line numbers in lines 30 and 40. Replace these two with a single space.

—The string " | asteris | ," which appears throughout the program. Change this string to "*".

You may obtain a disk copy of the program by sending a 5-¼" disk with mailer and return postage to the address at the beginning of this column. ■

Number 24 on your Feedback card

LETTERS

From the Hamshack

School Package Idea

I've been reading your magazine and editorials for about 10 years with interest. Your ideas about how to get the ham population growing are very good. I agree that we need radio clubs in the schools, but you and I both know that printing editorials has started very few clubs in the years that you've been talking about it.

The biggest help to growth has been that several clubs have set up a Volunteer Examiner program to hold exams before every meeting. We give about four or five exams each month, but almost every person we test JOINS OUR CLUB. Without the organized VE program, we wouldn't be giving exams. The club membership is at its highest level ever, and growing. The VE Program gave us a track to run on.

What is needed to get school radio clubs going is a comprehensive kit. This would cover all aspects of forming and maintaining a club: who to contact in the school, by-laws, meeting formats, meeting ideas, speaker sources, gear donation sources, and success stories. If done well enough, and properly marketed, such a kit could become a national standard, increasing its credibility to school boards.

Someone with access to writing/printing facilities and a known name and access to a national audience could gather these materials and ideas and package them for mass use. I know that this sounds like another dummy who says "you do it, I can't," but you are in a position to put this together. A request in an article or in your editorial for info and ideas from existing clubs should bring ideas and examples. Once put together, it should not be too expensive to print, so if you market it just to cover costs, the price should still be well within anyone's budget. I'll bet a lot of ham clubs would buy the package and that they could find a ham who would be the faculty advisor.

Wayne, I find it hard to believe I'm the first to suggest this. So why has it not been done yet? I think it's a fabulous idea.

Gary R. Lahr N6PBA
Mission Viejo CA 92691

Gary, you're right. If hams who have successfully overcome school bureaucracies and been able to get school radio clubs going will write in, giving details on how they did it, I'll be delighted to gather the material and publish it. . . Wayne

Japanese Licensing Requirements

With half the population of the US, Japan has more than one million hams, or four times as many ham operators. The monthly issues of the largest Japanese ham magazine, *CQ Ham Radio*, is more the size of a telephone book. Japan's ham clubs are full of high school students and enthusiastic newcomers. Why? We can find information on amateur radio licensing in Japan in *Amateur Radio Guide* by Kazuo Niwa JA1AYO.

Japan's Radiotelephone (Fourth Class) license requires radio knowledge at the Japanese junior high school physics level, plus regulations, and allows 10 Watts output on all bands except for 30 and 20 meters and all modes except CW. The Japanese allow a 10 Watt no-code license on most HF bands on the theory that operation at that power level will not cause harmful interference in other countries. In 1986, 1,368,083 Japanese held valid ham licenses. Of these, 1,232,493 held Radiotelephone licenses. Many hams never upgrade from Fourth Class.

The Radiotelegraph (Third Class) license requires a 5 wpm international Morse code test, but it has the same privileges as Radio telephone except that CW is permitted. In 1986, 78,934 people held the Radiotelegraph license.

The Second Class license requires radio knowledge at the high school physics level, plus radio regulations and a 9 wpm code test, but allows 100 Watts output on all bands. Japanese hams holding this license totaled 45,108.

The First Class license requires a junior college physics level of radio knowledge plus regulations, and a 12 wpm code test (see the *ARRL Operating Manual* for the Japanese Morse code). Only 11,548 hams held the First Class license in 1986.

The large Japanese ham population drives a high occupancy of their 430–440 MHz and 1260–1300 MHz bands. The Japanese have no 220 or 902 MHz ham bands. They just have 144–146 MHz at 2 meters.

The Japanese situation is so distinctive that it can only give us a few clues about what no-code licensing might look like in the US. The US no-code proposals I have seen are for operation on the VHF/UHF bands with an examination at about the level of the Technician or General in difficulty.

For the sake of a simple licensing structure and the convenience of the volunteer examiners, I believe the no-code license examination should be the technician examination minus the code test. Let's give the no-code licensees some limited access to 2 meters. Contact with higher class licensees on 2 meters will socialize them into good ham citizens and enable them to meet many other hams. Let's welcome them as full-fledged hams.

David Cowhig WA1LBP
Alexandria VA

Number 25 on your Feedback card

NEW PRODUCTS

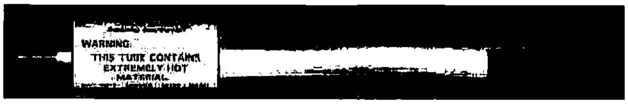
Compiled by Linda Reneau

PRODUCT OF THE MONTH

VideOsmith's SPECTRUM PROBE

The Spectrum Probe lets you design and repair electronic equipment faster and better. This probe causes a standard scope to display logarithmic amplitude vertical versus frequency horizontal. The frequency domain presentation, together with a large visible dynamic range of amplitude, provides a picture of circuit operation which has only been available with equipment costing much more, such as a laboratory spectrum analyzer. The laboratory spectrum analyzer is more flexible, but its input impedance is usually 50Ω. This is fine for VHF, but it would heavily load most circuits.

This Spectrum Probe has an input isolation capacitor of 10 pF, comparable to most scope low-capacity probes, to minimize loading of the circuit being probed. An adapter, supplied, allows you to calibrate and operate in a 50/75Ω coaxial system. The scope processes only a video signal. You can observe 100 MHz carriers through the Spectrum Probe with a 1 MHz scope. Price, $380. *VideOsmith, 1324 Harris Rd., Dresher PA 19025. (215) 643-6340.* Circle Reader Service No. 201.

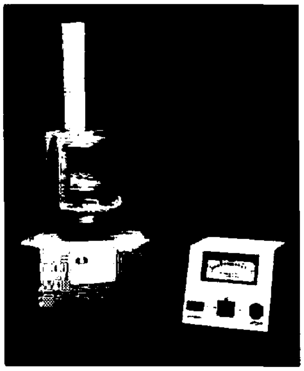


ELECTRON PROCESSING, INC.

In the field, the IRON SLEEVE™ lets you put your hot soldering iron back in your toolkit without having to wait for it to cool. That's a time savings of from five to ten minutes per service call. The IRON SLEEVE also protects the iron from tip damage.

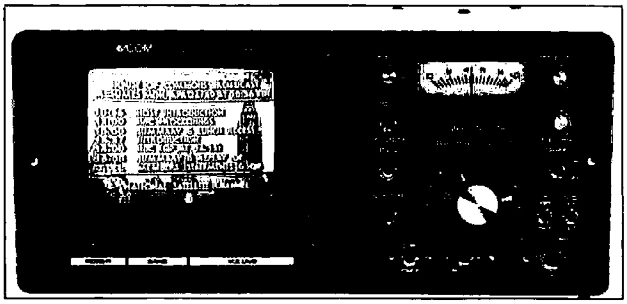
The IRON SLEEVE is a tube 11" long and 1.5" in diameter. It contains a proprietary heat absorbing mass. Most soldering irons of 50 Watts or less fit the IRON SLEEVE. It's held in place by a hook-loop strap. Prices start at $20, with quantity discounts available. *Sales Department, Electron Processing, Inc., (516) 764-9798. PO Box 708, Medford NY 11763.* Circle Reader Service Number 207.

ORION BUSINESS INTERNATIONAL, INC.



The new Orion OR-2300 antenna rotator, with worm gear drive, is rated at 35 square feet. Compact design allows crank-up and stacked-tower mounting. The large control box has easy-to-read direction indicator with variable speed.

The OR-2300 accepts mast diameters from 1¾ to 3⅛ inches. Flex-mount clamping corrects for misaligned masts and absorbs windload. Built-in thrust-bearing and double bronze bearing decreases friction and load transfer to gear set. Available through dealers. Suggested retail price, $895. *Orion Business International, Inc., PO Box 9577, Canoga Park CA 91309. (818) 888-4927. FAX: (818) 888-5112. Telex: 697-4899. ORION HT.* Circle Reader Service Number 202.

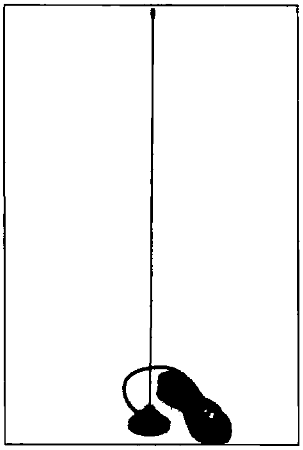


AVCOM

AVCOM'S portable test receiver, the PTR-25, is a battery operated satellite receiver. Its circuitry is derived from AVCOM's COM-2 and COM-3R satellite receivers. The built-in B & W TV offers reduced power consumption and longer battery life than comparable color units. A full range of outputs are available for large TV monitors, video recorders, and audio amplifiers. A special IF sampled output is available for observing the 70 MHz IF signal, including any terrestrial interference, on AVCOM's spectrum analyzers.

The signal strength meter on the front panel is large and easy to read. For dish peaking, the PTR-25 has an audible signal strength indicator. Other features include an internal AC supply, polarotor and polarizer controls, and fast recharge capability. For specifications, contact AVCOM. Price, $1525. *AVCOM, 500 Southlake Boulevard, Richmond VA 23236. (804) 794-2500. Telex: 701-545. FAX: (804) 794-8284.* Circle Reader Service Number 203.

VALOR ENTERPRISES, INC.



Valor Enterprises's Model PAQM "communications extender" mobile VHF antenna provides mini quarter-wave reception. You can easily install this 2 meter unit with the two-inch magnetic mount, 12-foot cable, and BNC connector, that come with it.

You can modify the unit for operation on 220 or 450 MHz. Price, $14.45. *Valor Enterprises, Inc., 185 W. Hamilton Street, West Milton OH 45383. (513) 698-4194.* Circle Reader Service Number 205.

Number 28 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

GRAND JUNCTION CO
JULY 1

The Western Colorado Amateur Radio Club, Inc., will hold its Hamfest at the Colorado National Guard armory. Tables, $5; admission, $2. VE testing. *Randy Martens NTØN, PO Box 3422, Grand Junction CO 81502. (303) 242-4205.*

WILKES-BARRE PA
JULY 2

The Murgas ARC will hold its hamfest at the Ice-A-Rama Sports Complex. Free parking, VE exams, electronic show, prizes, 110 V power, outdoor flea market ($3 per space), admission $3. Indoor table, $9. Talk-in on 53.61, 53.81, 146.52, 146.61, 444.825. *Mike Benish K3SAE, Box 214, Rd #1, Pittston PA 18643. (717) 338-6863.*

HARRISBURG PA
JULY 4

The Harrisburg RAC is having a Firecracker Hamfest at the Bressler Picnic Grounds. Admission, $3. Tailgating, $2. Tables, $5 in advance or $6 at site. Talk-in on 147.30/.90 or 52/52. Contact *Dave Dormer KC3MG, (717) 939-4957.*

INTERNATIONAL BOUNDARY
JULY 7-9

The International Ham Fest will be at Peace Garden, on the international boundary 14 miles north of Dunseith, North Dakota, on Highway 281. Camping facilities, primitive and modern, flea market, VE exams, special event station, Saturday night dance, ham and nonham activities. Contact *Tom Williams WDØATI, 612 S. 11th St., Bismarck ND 58504. (701) 258-1947.*

S. MILWAUKEE WI
JULY 8

The S. Milwaukee ARC will hold its 19th annual SWAPFEST at the American Legion Post #434. Parking, picnic area, free overnight camping. Admission $4, including a "happy time" with free beverages. Prizes, exams. Talk-in on 146.580 MHz FM simplex. *The South Milwaukee Amateur Radio Club, PO Box 102, South Milwaukee WI 53172-0102.*

HOBBS NM
JULY 8

KD5RZ will operate the 1st Annual National Royal Ranger Special Event (NRRSE) from 1300 to 0100 UTC, sponsored by the New Mexico Dist. Royal Rangers, a young boys Christian Scouting Organization (ages 12-18), Dept. of Assemblies of God. All amateur operators are invited to help their local Royal Ranger Outposts. Suggested frequencies: 3.870, 7.250, 14.250, 21.320, and 28.520/28.380. For certificate, send QSL and large SASE to *KD5RZ(NRRSE), 1420 N. Tasker, Hobbs NM 88240.*

ATLANTA GA
JULY 8-9

The Atlanta HamFestival will be at the new Georgia International Convention and Trade Center near the Atlanta Airport. Free parking, reasonable motels. *The Atlanta Radio Club, Inc., PO Box 77171, Atlanta GA 30357.*

MAPLE RIDGE B.C.
JULY 8-9

The Maple Ridge Hamfest will be at St. Patricks Center. Prizes, commercial displays, flea market, food, close to shopping and recreation center, camper space, no hookups. Talk-in frequencies: 146.20/.80, 146.34/.94. *Bob Houghton VE7BZH, Box 292, Maple Ridge B.C. CANADA V2X 7G2.*

INDIANAPOLIS IN
JULY 8-9

The 19th annual ARRL Division Convention and Hamfest will be at the Marion County Fairgrounds. New equipment dealers, computer and software dealers. Electronic fleamarket, technical forums, awards, nonham activities. Free hookup and camping. Motels close by. $6 at gate, children under 12 free. Indoor flea market, air-conditioned commercial building. Six large buildings. *Indianapolis Hamfest Association, PO Box 11776, Indianapolis IN 46201. (317) 356-4451.*

CHEYENNE WY
JULY 8-9

The SHY-WY ARC will host the "Wyoming Hamfest" at the Hiliday Inn. Dealer exhibits, indoor swap tables, forums, seminars, and VE exams. Admission, $3 in advance, $4 at door. Talk-in on 146.175/.775 or 146.22/.82. Contact *Fred Dumire N7JPR, PO Box 6262, Cheyenne WY 82003.*

BATAVIA NY
JULY 9

The 9th annual Batavia Hamfest, sponsored by the Genesee Radio Amateurs, will be at the Alexander Firemen's Grounds. Indoor commercial exhibits, spacious flea market, ARRL VEC exams, free camping (electric, $2), breakfast, chicken BBQ, OM/YL programs. Tickets $3 before July 1, $5 at gate. Talk-in on 144.71/145.31 and 146.52. *G.R.A.M., PO Box 572, Batavia NY 14020. SASE, please.* For tickets, write *Knute Carlson N2DRX, 26 Burke Dr., Batavia NY 14020.*

LONG ISLAND NY
JULY 9

LIMARC ARRL Long Island Hamfair will be at the New York Institute of Technology. Tailgating, no reservations needed, sellers car space, $5; general admission, $3. Nonham women and children free. Talk-in on 146.25/.85. Awards. Call *Mark Nadel NK2T, (516) 796-2366 or Hank Wener, (201) 694-1811.*

PITTSBURGH PA
JULY 9

The North Hills Amateur Radio Club announces its 4th annual Hamfest. It will be held at the Northland Public Library. Free admission, free dealer and tailgating space, free parking. VEC testing, ARRL table, prize drawings, handicap facilities. For VEC information, send SASE to *John Rosenwald NM3P, 400 Stevens Drive, Pittsburgh PA 15237. (412) 931-2651.* Preregistration suggested. For Hamfest information, send SASE to *Bob Ferrey, Jr., N3DOK, 9821 Presidential Drive, Allison Park PA 15101. (412) 367-2393.*

CATALINA ISLAND CA
JULY 9

Amateur radio station WA6OPZ will operate from 1500 to 0700 UTC from Emerald Bay, Catalina Island, to commemorate the Boy Scouts' use of this bay since 1925. Frequencies: around 28.45 SSB, and the lower 25 kHz of the 15, 20, and 40 meter General phone bands. CW operation will be around 7125 and 21150 kHz. For certificate, send QSL and 9x12 SASE to *Marshall Jacobson, 16441 Gilmore St., Van Nuys CA 91406.*

DOWNERS GROVE IL
JULY 9

The DuPage ARC will have its Hamfest-Computer Show at the American Legion Grounds. Indoor tables, outdoor Swapper's Row, free parking, handicap facilities. ARRL approved, VE license testing (bring a copy of your license). Tickets, $2; $3 at gate. Tables, $10; after June 10, $12. Talk-in on 145.25-600. *Hamfest Chairman, DuPage ARC, PO Box 71, Clarendon Hills IL 60514. Ed (312) 985-0527; Jim (312) 964-5529; Everett (312) 495-1253.*

UNION ME
JULY 15

The second annual Union Hamfest, sponsored by the Maine Hamfest Association, with be at the Union Fairgrounds. Packet radio, technical programs, paved sales and tailgating area, meetings for nets and clubs, and exams. Camping, breakfast, supper. Admission, $2. Tailgating and non-reserved sales space, $1. Talk-in on 146.22/.82 and 146.28/.88. *Maud N1EBC or John Peterson N1CBA, Box 601, Augusta ME 04330. (207) 445-2977.*

AUGUSTA NJ
JULY 16

The Sussex County ARC will sponsor SCARC '89 at the Sussex County Fairgrounds. Registration, $3. Indoor tables, $7. Tailgate space, $5. Free parking. *Don Stickle K2OX, Weldon Rd., RD 4, Lake Hopatcong NJ 07849. (201) 663-0677.*

WASHINGTON MO
JULY 16

The Zero-Beaters ARC will hold its 27th annual Hamfest at Bernie H. Hillerman Park at the Washington Fairgrounds. Flea market ($2 per space). FCC exams (bring photocopy and original license), seminars, dealer displays, nonham displays. Admission and parking free. Talk-in on 147.84/.24 and 146.52 simplex. *Al Lanwermeyer WBØQBS, 909 Nora St., Washington MO 63090. (314) 239-2072.*

WOODLAND PARK CO
JULY 22-23

The Mountain Amateur Radio Club will hold its Annual Swapfest/Campout in the Pike National Forest. Free parking, dealers, swap 'n shop, get-togethers. Advance reservations required for overnight camping. Sellers and overnight campers, $5 per space per day. Talk-in on MARC repeaters 145.16 and 448.65. *MARC, Box 1016, Woodland Park CO 80866. Joe Tafoya NØCMD, (719) 687-3641.*

GLENWOOD SPRINGS CO
JULY 29

The Ski Country Amateur Radio Club Hamfest will be at the Colorado Mountain College Community Education Center. Swap tables, VE exams, free admission. *SCARC, PO Box 302, Carbondale CO 81623. (303) 945-9342.*

ISHPEMING MI
JULY 29-30

The Hiawatha ARA will sponsor their Upper Peninsula Ham Fest this year at the Marquette Lake View Arena. Large indoor display area, prizes, plenty of parking. *George Uuro N8HVT, Secretary, Hiawatha Amateur Radio Association, Rt. 2, 100 North Daisy, Ishpeming MI 49849.*

BALTIMORE MD
JULY 30

The BRATS Maryland Hamfest will be at the State Fairgrounds in Timonium this year. 8-foot tables are $35 each or 3 for $100, in the Main Exhibit Hall. Fleamarket tables, $20 each. Tailgating space, $5 per vehicle. Admission, $5 per adult, children under 12 free. Free VE exams. Talk-in on 146.16/.76, 147.63/.03, 146.52. *BRATS, PO Box 5915, Baltimore MD 21208.*

PEOTONE IL
JULY 30

Hamfesters Radio Club announces its 55th annual hamfest at the Will County Fairgrounds. Air-conditioned dealer displays, large outdoor flea market, FCC exams. Talk-in frequencies are 146.52 simplex and 146.76/.16 CFMC repeater. *Don Burch N9DWI, 8438 S. Kolin Avenue, Chicago IL 60652. (312) 582-9776.*

Never Say Die continued from page 53

able to get some nice testimonials. At $10 a page it isn't like it's a major advertising investment.

Run your advertising department professionally. It's okay to press members into service as ad sales representatives. Hand out the assignments at meetings. Be sure you get an okay for the ad from the advertiser before you run it. You're probably going to have to set the type yourself. If there's a photo you can charge the advertiser for the cost of the halftone, but not for the typesetting. Be sure every advertiser has okayed his ad and knows it is going to run. They can get awfully mad if you run an ad without permission one month and then bill them for it. That's one way to lose a customer, and his friends.

Another source of income is from small ads by club members with used ham gear (or anything else) for sale, or wanted.

Printing

If you have a small club and only need a hundred copies you might make a deal with someone in the club with a photocopier to buy the paper and run off the pages that way. All you have to do is come up with the copy-ready pages with the computer. This, alas, will limit your use of photos severely. Photocopiers make mud of pictures, so you'll want to depend on line drawings. If you have an artist or cartoonist in the club you're all set.

It costs a bit more, but with quick-printers everywhere, not much more, if you go photo offset. Then you'll be in great shape to include pictures. For a little extra you can even go to two colors—if your printer has a two-color press. If he doesn't, you're looking at a higher cost when he has to clean the black ink off the rollers, re-ink them with red and run the paper through the press a second time.

Most printers have offset presses that will handle 11" x 17" sheets. This will allow you to print eight pages on one sheet of paper if you make your page size 5½" x 8", which is pretty standard. It's easier to see on the Mac than 8½" x 11", too. Thus, two press sheets will give you a 16-page newsletter, allowing about eight pages for ads ($80). The printer should be able to fold and trim the pages for you in eight-page sections, making it simple to insert one in the other and zap in a staple to hold them together.

Printing prices vary somewhat so if you start a club newsletter please let me know your total costs per issue so I can pass along the information to help other clubs. I'm interested, too, in seeing your balance sheet for the project, showing income from ads and all of your expenses. Only in communist countries is there any problem with making a profit, so make it make money for the club if you can.

Mailing

The same Macintosh that does the finished pages for you can print out the self-sticking mailing labels. Try to remember to leave a spot for the label on the cover of the newsletter. If you forget the first month I guarantee you'll remember it from then on.

For postage you can save money by getting a permit and printing the permit number on the newsletter. Check with your postmaster for details. It beats the heck out of licking rolls of stamps.

Be Conservative

The Mac is capable of doing all sorts of amazing things so you're going to have your hands full keeping the editor from showing off a hundred different fonts in each issue. Be firm . . . make him stick to the same type fonts all through the newsletter and not go berserk with Old English, German Script and so on.

Macs make it easy to repeat artwork, so your club artist can come up with some cute drawings that you can put here and there, changing sizes as you wish. A friend of mine who was into computers early on had a thing about dragons (he still does), so he embellished his newsletter (People's Computer Company) with all sorts of dragons—and that was before the Macintosh.

The typesetting programs handle H & J (hyphenating and justification), so don't go avant-garde with ragged right copy: it's too hard to read. Also, I highly recommend the use of a serif style of type for body copy, and sans-serif for titles. You don't know what a serif is? Tsk, look it up.

A good newsletter will keep your club growing and active. There's nothing better to make sure members don't miss a meeting, and to get local hams to break down and join the club. If your club is giving Novice classes the newsletter is a great place to run pictures of the prospective hams and to reward them when they make it. Can you get the newsletter posted on the bulletin board in your local grade and high schools? Have you forgotten to send a copy to your local newspaper editor and radio station?

If your club is on the ball and working hand in hand with local service groups such as the Lions, Kiwanis, Elks, Masons, and so on, you can run articles on your club support activities in your newsletter and see that extra copies are sent to the service club to be distributed at their next meeting.

These service clubs often do community work where communications is helpful. It may be cleanups, walking for dollars, marathons, auctions, car rallies—whatever it is, your club should be able to help with communications. If you have anyone in your club who is good at speaking, have him address these service clubs and explain the value of amateur radio to the community and to the country. With any luck you'll run across some teachers or even school officials—and it's just a step from there to getting kids interested.

If your club does get a newsletter going I'd appreciate being on the mailing list. And if it does as well for your club as newsletters are doing for others, I'd like a note from you I can publish in *73*. It just might get more clubs off dead center. Sometimes it takes a lot to stir up ham clubs which are in the hands of old timers.

Reviews

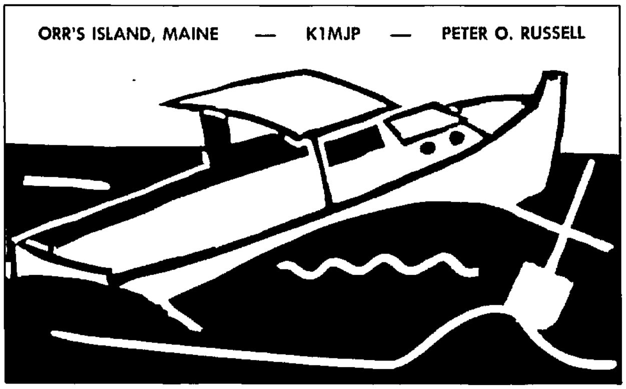
We are looking for readers who'd like to help out at home. You can let us know how you like any new piece of equipment you buy. With all the great new stuff coming out, you'd expect a flood of reviews. By this printing, some of you will have already some months' operating experience with the new ICOM 725 and 765 HF rigs, or Yaesu's new 1020 HF rig—why not tell us about them? If feedback is any indication, the readers are clamoring to know about them. No, we're not interested as much in a laboratory report as we are in a ham shack/operator's report.

When I'm thinking of buying something new, which is most of the time—a lot of thinking, not so much buying—I want to know what others who've bought it have found. Is it easy to use? Is it fun? Does it do everything the ads say? What do I need to go with it? I want to know how it was for you and how you think I'll like it.

Wouldn't you rather know how other average hams make out with new gear than read a scientific lab report? On a transceiver, how useful are the memory channels? How easy is it to change bands? What kind of signal reports does it bring? Will it control my amplifier all okay? What problems may I run into?

Let's say you've finally made the big move and bought a packet unit. What happened? How has it worked out for you? Are you happy with it or do you wish you'd bought another? How was your first packet QSO? Are you having fun? Would you recommend we all give it a try? Any helpful ideas to make our packet experience more fun?

I'm not going to be satisfied until I'm able to publish reports from users on every new piece of ham gear, from the largest to the smallest. I want to be able to look back in *73* and find out enough about anything I'm interested in to make a buy/no-buy decision. ■



QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock, NH 03449, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

Number 30 on your Feedback card

TECH TIPS

Pearls of Tech Wisdom

Cheap Tube Heatshrinking

Heat guns sold for use with heatshrink tubing are quite expensive, costing $100 or more. Other methods, such as hair dryers, electric heaters, propane torches, and soldering irons, have their disadvantages and may even be dangerous. However, there is an inexpensive solution.

Heat gun paint strippers under such brands as Wagner, Black & Decker, and Craftsman have become quite popular in the last year or two. I bought one of these heat guns, but I have yet to remove any paint! It works perfectly for heatshrink tubing. It heats up quickly, and you can easily control the amount of heat by controlling the distance of the gun from the tubing.

These paint stripper guns typically cost $20–30. One brand sold for $15 after rebate. What a bargain!

W.C. Cloninger, Jr. K3OF

Fix for TS-430 Blank Out

Did you ever wonder why the receiver blanks out below 150 kHz on the Kenwood TS-430S? I have! So, since I love to experiment on my own TS-430S, I went about the task to find out why. It seems that the VCO signal was being switched off by IC1 via Q16 on the PLL Unit (X50-1910-00).

To remedy this, cut R52 (47k ⅛ Watt resistor) located next to Plug 4. I did not measure the sensitivity below 150 kHz, but I was able to receive the Russian woodpecker at 100 kHz at S-5 on my S-meter. Not bad for a receiver not designed to go down that low. (Reprinted from *International Radio and Computers, Inc.*, the IRI Kenwood Newsletter, November/December 1988, Issue 90.)

Craig Fay N7ETV
Las Vegas NV

Better AM on R7000

This simple procedure will narrow the AM selectivity from the factory AM filter preset of ±3.0 kHz at −6 dB. See page 33 of the Owner's Manual for a top view of the RF/IF units.

Remove the receiver's complete top cover. Be careful of the speaker leads which are plugged into the unit. Locate J8 in the IF units. Carefully lift the shorting connector straight up from the factory preset WIDE position and press it down firmly into the NAR position. Replace the top cover and enjoy the receiver's improved AM selectivity. (Reprinted from *International Radio Inc.*, ICOM* Newsletter, April 1988, Issue 84.)

Rene Borde
Monitoring Times

220 AMP TVI

Those who have a Ramsey Electronics PA-20 220 MHz power amplifier (2W in—10W out) may have noticed extensive TVI on channels 11 and 13. The fix is to replace the PIN diode at the transceiver input end of the receive pre amp with a MPN 3401 or similar unit with higher isolation than the original. Problem solved. (Reprinted from *NCARC Communicator*, Vol. 5, Issue 7.)

Bill K1LNJ
KB8CI PBBS

Number 31 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free, on a space available basis. Please type or neatly print your request on a full-sized sheet of paper. Use upper and lower case letters—not all capitals. Be sure to print numbers carefully. A "1" and "I"; "7" and "T" or "l" and other numbers and letters can be easily misread when they are not printed clearly. "U" and "V" can also be confused. Thank you for your cooperation.

After about forty years, I sold my SX-88, and uncovered a considerable interest in the history of this old receiver. Now, much as car enthusiasts have done with cars, I am attempting to locate as many past and present owners as possible of these old receivers. Anyone interested is invited to write.

Also, I have an AZDEN 4000 2 meter rig which needs service, and I can't find out where to send it. Is this outfit still in business?

And finally, I'd like to know if anyone handles parts for the old Hallicrafters.

Bob Forman W9RJH
Monmouth IL 61462-0068

Looking for info to convert the Swan Mark 1 from 3-300Z to 3-500Z tube finals.

Kuby Kubichek
19254 Tranbarger St.
Rowland Hts. CA 91748

Having built the G4ZU (Dick Bird) Super Mimi Beam, I'm interested in results others have had.

A. Kohler W0JHC
842 5th S.E.
Mason City IA 50401

I will pay copying and postage costs for operating manual and schematic, but operating manual primarily for MULT-TECH MODEM model MT212A.

George L. Coleman KA0ZIP
600 South 27th Street #103
Omaha NE 68105

Does anyone have a schematic on a TELCO COUNTER 40, a 40 MHz frequency counter, Model CT-40, MFG. TELCO PROD. CORP. GLEN COVE NY? The corporation is no longer in business. I will pay copy cost.

L.F. Boeckerman
4248 Barth Ln
Kettering OH 45429

Needed: power transformer for an old Heathkit HO-10 Monitor Scope. Thanks.

John R. Somers KC3YB
93-25 Beechwood Place
Crisfield MD 21817

I'm looking for the schematic for the RCA 14T302 CB to convert to 10 meters. Will pay reasonable copying and shipping costs.

Chris Cinalli KA3UGA
819 Stella Ave.
Croydon PA 19020

BARTER 'N' BUY

QSLs TO ORDER. Variety of styles, colors, card stock. W4BPD QSLs, PO Drawer DX, Cordova SC 29039. BNB260

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ELECTRONIC KITS & ASSEMBLIES. For our latest catalog, SASE (45¢) to: A&A Engineering, 2521 W. LaPalma, #K, Anaheim CA 92801. BNB624

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Number 33 on your Feedback card

PROPAGATION

by Jim Gray W1XU

Jim Gray W1XU
PO Box 1079
Payson AZ 85541

Conditions in July will be spotty. The first ten days of the month will be good to fair for the HF bands. The 11th through the 18th will be poor. The 19th through the 22nd will be good to fair, and the 23rd through the 27th poor to fair, increasing to good for the last four days of the month.

DX in the summer doesn't look good for the HF bands, BUT look on 6 and 2 meters for excellent opportunities during the second and fourth full weeks of the month. On many days, the Earth's magnetic field will be unsettled to active, rising to storm levels around the 4th, 14th, and 25th.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	-	-	-	-	20	20	20	-	-	-	15
ARGENTINA	15	20	20	20	-	-	-	-	-	10	10	10
AUSTRALIA	-	-	-	20	20	20	15	15	15	-	-	-
CANAL ZONE	15	15	20	20	20	-	20	20	15	10	10	10
ENGLAND	20	20	*40	-	-	20	-	15	15	20	20	20
HAWAII	15	15	15	20	20	40	20	-	-	-	15	10
INDIA	15	20	-	-	20	20		-	-	-	-	-
JAPAN	15	-		-	-	20	20	20	-	-	-	15
MEXICO	15	15	20	20	20	-	20	20	15	10	10	10
PHILIPPINES	20	15	20	20	-	-	20	-	-	-	-	-
PUERTO RICO	15	15	20	20	20	-	20	20	15	10	10	10
SOUTH AFRICA	-	-	-	20	20	-	-	15	15	15	20	20
U.S.S.R	20	20	20	20	-	-	20	-	-	15	15	20
WEST COAST	*15	*15	80	80	80	-	20	20	20	20	15	15

CENTRAL UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	-	15	15	-	-	20	20	20	20	-	-	-
ARGENTINA	15	15	20	20	-	-	-	-	-	10	10	10
AUSTRALIA	15	15	15	20	20	20	20	20	-	-	-	-
CANAL ZONE	15	15	20	20	20	20	20	20	20	15	10	10
ENGLAND	20	20	20	40	-	-	-	-	-	-	-	15
HAWAII	10	15	15	20	(1)20	(1)20	20	20	-	-	-	-
INDIA	(1)20	(1)20	-	-	-	-	20	-	-	-	-	-
JAPAN	-	15	15	-	-	(1)20	20	20	20	-	-	-
MEXICO	15	15	20	20	20	20	20	20	20	15	10	10
PHILIPPINES	20	20	15	20	-	-	-	-	-	-	-	(1)20
PUERTO RICO	15	15	20	20	20	20	20	20	20	15	10	10
SOUTH AFRICA	-	-	40	20	-	-	-	-	15	20	20	-
U.S.S.R	20	20	20	-	-		-	-	-	15	15	20

WESTERN UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	15	20	20	20	20	(1)20	20	15	20	-	15
ARGENTINA	10	15	15	20	(1)20	-	20	20	-	-	-	15
AUSTRALIA	10	10	15	15	20	20	40	40	20	-	-	-
CANAL ZONE	15	15	20	(1)20	(1)20	40	80	-	-	(2)15	(2)15	15
ENGLAND	15	20	20	20	-	-	-	20	15	15	-	15
HAWAII	15	15	15	20	20	40	40	20	-	-	15	10
INDIA	-	-	15	-	-	-	20	20	20	15	-	-
JAPAN	15	15	-	20	20	20	40	20	20	20	-	15
MEXICO	15	15	20	(1)20	(1)20	40	80	-	-	(2)15	(2)15	15
PHILIPPINES	-	-	15	-	-	20	20	20	15	15	-	-
PUERTO RICO	15	15	20	(1)20	(1)20	40	80	-	-	(2)15	(2)15	15
SOUTH AFRICA	-	-	-	20	20	-	-	20	20	15	-	-
U.S.S.R	20	20	20	20	20	-	-	-	-	-	-	-
EAST COAST			80	80	80	-	20	20	20	20	15	15

JULY

SUN	MON	TUE	WED	THU	FRI	SAT
						1 F-P
2 P	3 P-F	4 F-G	5 G	6 G	7 G	8 G
9 G-F	10 F-P	11 P	12 P	13 P	14 P-F	15 P-F
16 P-F	17 F	18 F	19 F	20 F-G	21 G	22 G-F
23 F-P	24 P	25 P-F	26 F	27 F	28 F-G	29 G
30 G	31 G					

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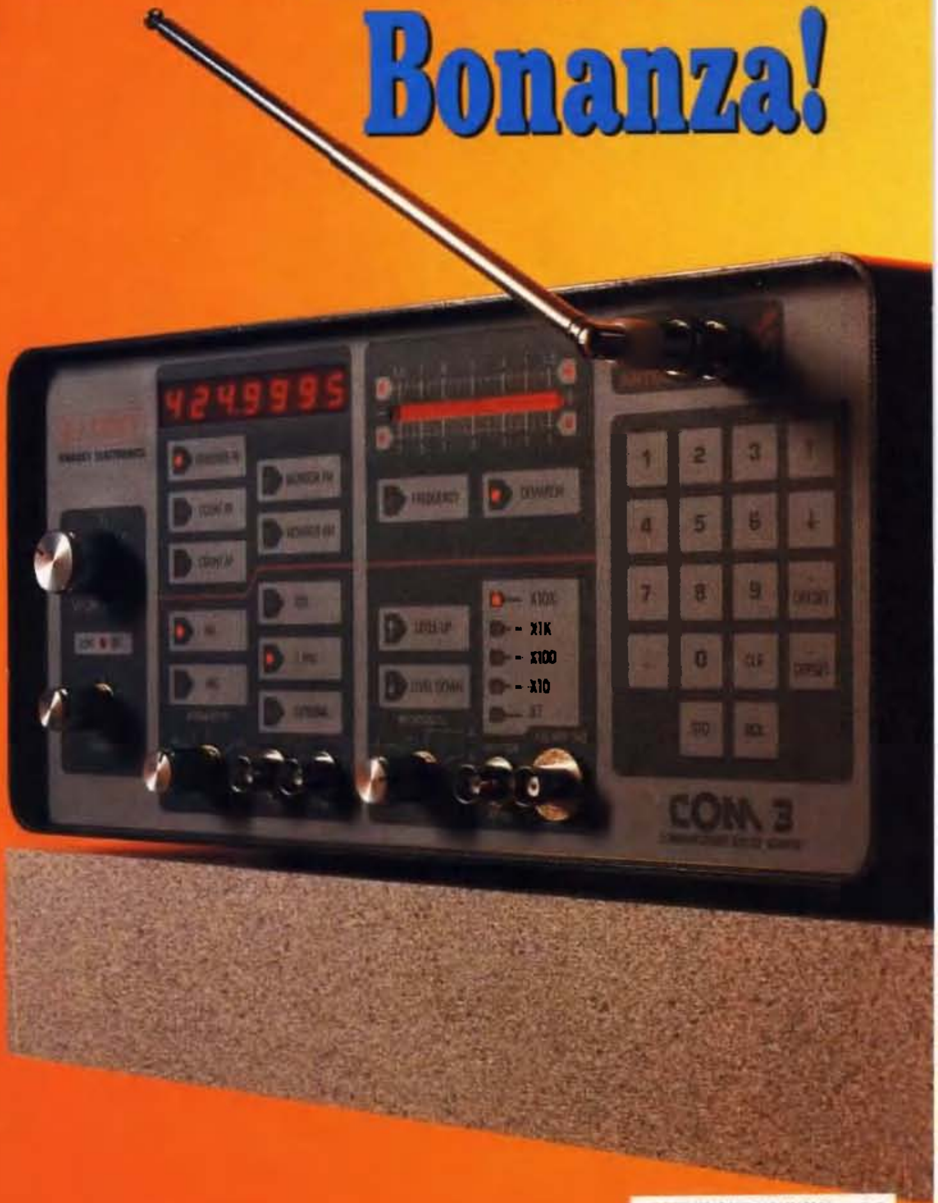

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AUGUST 1989 Issue # 347

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FEEDBACK . . . FEEDBACK!
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Cover of Ramsey COM-3 service monitor by Marilyn Moran

See our new department "Ham Profiles" for more on Diane KG5CS

Welcome, Newcomers!

The Universe Electric

In 640 B.C., Thales, a Greek philosopher, theorized that electricity was the soul in matter. Today we describe electricity as the flow of electrons. The **electric charge** is inherent in all matter, and when the positive-negative balance is disturbed, a net charge is created. Like charges repel each other and unlike charges attract each other. You can see the effects of electrostatic repulsion in clean, newly combed hair.

Displays of electrical activity, such as lightning, have always fascinated philosophers, scientists, and children. Do you remember, as a child, rubbing your blanket in the dark to see the sparks fly, or making a balloon stick to the wall? Warnings to stay away from the AC outlet? Did that peak your curiosity? Something really amazing must be inside there for Mom to get so excited when you try to explore it with a fork.

Phosphenes, those bright spots which appear before your eyes whenever there is a lack of external stimuli, can be induced by an electrostatic generator. In the 18th century, phosphene parties were popular, and Benjamin Franklin, kite-flyer and statesman, took part in at least one. People would sit in a circle and hold hands, letting themselves be shocked by an electrostatic generator. Each time the circle (circuit?) was opened or closed, they would see phosphenes. (Scientists still do not know exactly what phosphenes are, or how electrical stimulation or lack of stimulation produces them.)

Measuring Electricity

In 1751 Benjamin Franklin published *Experiments and Observations on Electricity*, which became the standard for electrical research for more than a generation. Since he left school at age 10, the work was entirely nonmathematical, but it inspired a French engineer, Charles Coulomb, to perfect a contraption called the "torsion balance." Experimenting with it, in 1789 he discovered the law of electrical force and proved that electricity obeys an inverse square law.

The inverse square law describes a relationship in which, under certain conditions, the intensity of a spherical wave varies inversely with the square of its distance from the source. Now measurable, electricity could be studied scientifically.

Named after the man, one **coulomb** is equal to the charge on 6,280,000,000,000,000,000 electrons, or in scientific notation, 6.28×10^{18}. When one coulomb of electrons moves past a fixed point in one second, we say the current is 1 **ampere**. The ampere, or **amp**, named after André Marie Ampère, is the unit we use to describe the amount of current. In *73* features, you'll see these abbreviations: A or amp, for ampere; **mA**, milliampere (0.001 of an ampere); and **mAh**, milliamp hour(s). The last unit describes the amount of current flowing past a point for a given amount of time.

In mathematical expressions, the current is represented by the letter **I**, for **intensity**. This is the first of the three most important electrical quantities all hams should be familiar with.

Although very old devices which may have been voltage cells have been found in unlikely places, we credit Count Volta, an Italian, with making the first battery in 1796. He was the first to describe **voltage**, or electrical potential. Voltage is the amount of work done in moving a unit charge from one point to another against the electric field. Often compared to the water pressure in a pipe, it's the electric potential difference between two points; there is an excess of electrons at one point, and a deficiency of electrons at the other point. The universe being the way it is, the free electrons will rush in to fill in the gaps.

Mathematically, voltage is represented by the letter **E**, for **electromotive force** or **EMF**, or by the letter V for volts, the units of voltage. One volt across 1Ω of resistance causes a current flow of 1 ampere. Voltage is another of the three important electrical quantities.

The third electrical quantity, the unit of the measurement of resistance, is the **ohm**, symbolized by the Greek letter **Ω**. Mathematically, it's represented by the letter **R**. One ohm is the amount of resistance which will limit the current to one ampere when one volt is applied across the circuit.

In the early 19th century in Germany, Georg Ohm discovered that a current in a circuit is directly proportional to the electric pressure and inversely to the resistance of the conductors. We call this **Ohm's Law**. Mathematically, it's expressed as **E = IR**. If you know any two of these quantities, its easy to find the third. You can transpose the terms to solve for either current or resistance: **I = E/R** and **R = E/I**. The watt, product of the voltage and the current (IV or IE), is the unit of electrical power. In formulas, it's represented by the letter **W**. Fractions of the watt, such as **mW** (milliwatt, or 0.001 watts) and **μW** (microwatt, or 0.000001 watts) express low power. For larger power levels, we have **kW** (kilowatt, or 1000 watts) and **MW** (megawatt, or 1,000,000 watts). You will also see **Wh** (watt hour) and **kWh** (kilowatt hour). These last two represent the amount of power expended continuously for a given amount of time (one hour).

Electron Matters

Electricity is a highly versatile form of energy in both its **static** and **dynamic** forms. Materials such as copper, gold, silver, lead, and many other metals, which are composed of atoms which have less than four electrons in their outer shells, tend to be **conductors** because they are electrically unstable. They lose electrons easily, and these free electrons make the electric current possible.

In an electric current, a free electron doesn't travel from one end of the circuit to the other. Each electron only travels a short distance before colliding with another atom, knocking off more electrons, which in turn collide with other atoms.

Materials composed of atoms which have more than four outer shell, or valence, electrons tend to be **insulators**, or poor conductors, because they are electrically stabler. They hold onto their electrons and grab free electrons to fill in their outer rings (eight valence electrons, a full shell, gives complete electrical stability). Some insulators are wood, plastic, and glass.

An element with four valence electrons in its atoms, such as germanium and silicon, are generally **semiconductors**. They are neither good conductors nor good insulators.

An atom which has the same number of orbiting electrons as it has protons in the nucleus, is electrically balanced or neutral. A **negative ion** has a surfeit of electrons; it is negatively charged. An atom which has lost electrons is called a **positive ion**, or cation; it is charged positively. Positively charged particles, such as *holes* in solid state electronics, can also produce an electric current.

DC and AC

DC (direct current) is a constant-value electrical current that flows in only one direction. The **amplitude**, or strength, remains at a constant level.

AC (alternating current) is a flow of electricity that constantly changes in **magnitude** and **polarity**. Magnitude refers to *how much* current is flowing, and polarity to the *direction* of the flow, positive or negative, through the circuit. An AC wave rises from zero to maximum voltage in one direction, decreases to zero, reverses itself and reaches the maximum in the opposite direction, and decreases to zero again. This is one **cycle** of an AC wave. A basic AC wave is called a sine wave; it moves sinuously, like a snake.

The number of cycles per second, or cps, is the **frequency** of the current. One cycle per second is one **Hertz, or Hz**, named after Heinrich R. Hertz, who showed that electromagnetic waves propagate in the same way as light waves.

Radio frequency waves, which are AC waves, begin at 20,000 Hz (20 kHz), and go above 300 billion Hz (300 GHz). Since this range is vast, for convenience we use the standard metric prefixes with Hertz: kilo (1,000), mega (1,000,000), and giga (1,000,000,000). Thirty kilohertz, for example, is 30,000 Hertz. Combined with Hertz, these are abbreviated **kHz, MHz**, and **GHz**. Frequencies below 20 kHz are called audio frequencies.

Harnessing Electricity

Electricity is not a solid, a liquid, or a gas. Is it the soul in matter, the flow of charged particles, or both? How will we describe electricity fifty years from now?

When you turn on your **transceiver** (transmitter/receiver), you're harnessing one of the basic energies of the universe. By understanding the properties of electricity, developing a system to measure it, and providing the hardware to channel it, you can use it to communicate with people all over the world. And that's no small accomplishment.

...de Linda Reneau

Number 2 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Are You Fighting Change?

Whenever I run into a staunch Morse Code supporter, I can't help but marvel at how out of touch many hams are with the changes technology has made, not just in amateur radio, but the whole world. Indeed, it is this inability to cope with changes which is helping to sink our country economically. This isn't a vague philosophical problem, it's one which is having a major impact right now on your ability to make a living and is going, even more, to change things enormously for your children and grandchildren.

Just a generation ago we imported only a small percentage of the things we buy. Indeed, the term "imported" was quite a cachet which meant "unusual." Today it's getting so almost everything is imported. How'd that come about and what's it mean?

Technology is what happened. Today's low-cost transportation and communications has made it possible for the steel worker in Korea to be in direct competition with the steel worker in Pittsburgh—for the car assembler in Japan to be in direct competition with the worker in Detroit. A generation ago the costs of transportation and communications added so much to prices that direct foreign competition was difficult and imports tended to be specialty items.

Farm and Factory

Look at the changes technology has made in farming. When I was young, half of the American people were farmers. Then came improved transportation, such as railroad refrigerated cars and trucks, making it possible to sell farm products anywhere in the entire country instead of just locally. This inevitably brought on farm automation and truck farms. Now we call it agribusiness—and we see small farmers fighting a losing battle. Today, under 2% of our population are farmers.

Unless our unions recognize what's happened and make it possible for our factories to compete on a more equitable basis with foreign producers, we're going to keep losing jobs. The last I heard, our car unions had, with the backing of the government, forced car makers to pay roughly double the average American wage to their members—and they've lost over 200,000 jobs in recent years. Is it any wonder America has been losing more and more business to imports? Even if their cars were made as carelessly as ours, they'd still be able to undersell us.

What about automation, you ask? Fine, that cuts assembly costs, but we have to go some way to out-automate our foreign competitors. Korea may have low wages compared to us, but some of their electronic factories I've visited are way ahead of anything I've seen in the US in automation—and I get around.

Prohibitions and Restrictions Don't Work

This is a very basic problem—one which trying to set up import restrictions isn't going to solve—indeed, will only make worse. Trying to get us to "Buy American" isn't going to work, either. Few Americans are going to put up with poor quality and higher prices. That'll just build a black market. Name one product people really want which laws have been able to keep out.

They tried it with liquor and the black market that developed laid the foundations for today's tax-free organized crime industry. They tried it with drugs, only to make crime an even bigger business. Recently they tried it with IC chips, which quickly began pouring in via Canada to fill the need.

If we can no longer compete with countries who have lower wages on mass produced products, how are we going to stay in business? America's industrial strength was built on blue-collar mass production and now we're losing that edge—permanently. We can't uninvent jumbo jets, containerized shipping, and the whole trucking industry.

The weakening of our large firms can be seen in their gradual shrinking—the layoffs at the automobile firms, layoffs at steel firms (half the workers have been laid off so far). The only growth in jobs we've had in the last few years has been in small business. Perhaps it's time to start investing more in this growth market.

Investing in Small Business

Japan, Inc., may be able to raise Cain with our car market, and the Philippines with our shoes, but when it comes to short-run special products, they can't compete with our thousands of small companies. Unfortunately there seems to be virtually no recognition of this major change in the economy, so our tax laws still are forcing as much production overseas as possible. Indeed, if we had as a basic government policy the destruction of our small manufacturing businesses we could hardly be more effective.

Continued on page 88

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock, NH 03449, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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QRX . . .

EDITED BY BRYAN HASTINGS NS1B

WB6NOA Industry Service Report

Ever wanted to throw a bouquet or a brickbat at a service department of an amateur radio equipment manufacturer? Now's your chance!

Gordon West WB6NOA, noted ham educator and prolific author of a wide range of amateur radio related articles, has embarked on an industry service study, to appear in print in the first half of 1990. As part of his study, West will visit the US divisions of major amateur radio equipment manufacturers, and interview the heads of the service departments at each company. West will also outline in his report what hams can do on their part to achieve smoother and more efficient service.

The most important part of his report, however, will be YOUR input. Send a self-addressed envelope to Gordon West to obtain the service survey. He wants to hear from anyone who feels they have something important to say about their dealings with these service departments. Was customer support prompt and courteous? Were equipment repairs turned around quickly? Which companies have given you good service? Bad service?

Please send your SAE, dated no later than November 30, 1989, to: Gordon West WB6NOA, 2414 College Rd., Costa Mesa, CA 92626. ATTN: Service Survey. You may also download the survey form from the *73* BBS (see connect info below, in "Thanks"), from the /73mag SIG.

"I Hear You"

Our apologies to Debra Davis N7IHY, the operator of the ATV mobile station on the cover of the July Microwave/Video issue. The cover credit incorrectly listed her call as KA7FPL.

Deb has been in the amateur radio industry for almost a decade, including a lengthy period with ICOM, America. She currently serves as Marketing Manager for Advanced Electronic Applications (AEA) of Lynnwood, Washington.

Trade Sanction

The price of amateur gear that operates above 400 MHz could double as the result of a proposed 100% U.S. Import Tariff on such gear.

The *Federal Register* of 8 May carries notice of a hearing by the United States Trade Representative, to review telecommunications trade with Japan on 24 May. The hearing is being held pursuant to Section 1377 of the Omnibus Trade and Competitiveness Act of 1988, and, among other matters, will bring up the possible imposition of a 100% trade tariff on all radio gear from Japan capable of transmitting and receiving signals on frequencies at and above 400 MHz.

The proposed tax is a response to certain Japanese restrictions on telecommunications trade, primarily in dealing with the use in Japan of US-made third party radio and cellular telephone products. The Japanese Ministry of Post and Telecommunications has kept a cellular system that uses American-built gear from operating in several cities, even though spectrum is available for such services.

New Part 97 Released

Amateur radio has a new Part 97 regulatory base to guide it into the 21st century. This revised base was approved by all current Commissioners by unanimous vote on 31 May. See details on this revision in this month's "Looking West."

Ham Help, Tech Tips

For the moment, we have few "Ham Help" or "Tech Tip" items, so these submissions stand a good chance of running very soon. Send them to us in hard-copy, or upload them to the *73* BBS (see connect info below, in "Thanks"), to the SIGs "/Hamhelp" and "/Techtips."

No Special Callsigns

The FCC dropped plans to permit special amateur callsigns assigned by an entity or entities in the private sector. After reading all comments and proposals on PRB-3, the Commission said it recognized that, while the amateur community wanted this service, there was no way to implement it without diverting funds from the current licensing system. Amateurs will have to continue to make do with callsigns assigned at random by the FCC computerized licensing system.

Commissioner Bias?

Mimi Dawson, former FCC Commissioner, joined the law firm of Wiley, Rein, and Fielding. This is the same group of lawyers that is handling UPS's lobbying effort for spectrum for their digital voice national dispatch system in the reallocated 220–222 MHz amateur band.

President Bush is now considering, among others, Sherrie Marshall to replace Ms. Dawson. Interestingly, Ms. Marshall is currently an attorney of the above-mentioned law firm!

If Ms. Marshall is nominated and confirmed by the Senate, it would likely be a blow to the amateur community in the matters of retention of current spectrum allocations and in issues such as the fight to reverse the reallocation of the lower 40% of 1-1/4 meters to Land Mobile. Further, it would make it difficult if not impossible for a three-member Commission to effectively and impartially deal with the 87-14 reallocation, possibly forcing the FCC to go to a four member or full five member level to function on this issue.

Armenia Follow-up

Vern Riportella WA2LQQ, former AMSAT president, visited and interviewed Leonid Labutin UA3CR in Moscow, and learned from him that the six packet stations sent from the US to assist communications for the Armenian earthquake will now be used in Project Search, a network to help reunite families separated by the quake disaster.

The complete interview between UA3CR and WA2LQQ covers just about every aspect of amateur radio and amateur space activity in the Soviet Union. This interview was scheduled begin running in serial form in the *Westlink Report* newsletter in late June.

ANARC BBS

The Association of North American Radio Clubs Computer Bulletin Board System will have moved back to Kansas City by 1 July. The new BBS phone number is (913) 345–1978, and the new mailing address is PO Box 11201, Shawnee Mission, Kansas, 66207-0201. Use the same number and address to reach the Association of Clandestine Enthusiasts (ACE) radio monitoring organization.

Feedback Winner

Congratulations to Ralph Tafel WA8RLV, this month's feedback card draw winner! Winners receive a free 1-year subscription to *73 Magazine*. Future feedback winners will be listed in "Feedback."

Thanks!

. . . to all those folks who contributed to this month's QRX. They are *Westlink Report*, *220 Notes*, N6AHU, and W5KNE. Keep those ham radio related news reports and photos rolling in to *73 Magazine*, WGE Center, Forest Rd., Hancock NH 03449, ATTN: QRX. You may also submit news items to the *73* BBS at 603-525-4438, 300/1200 baud, 8 data bits, no parity, and one stop bit. Upload items to the /QRX SIG.

CTCSS, Fast and Cheap

Low-cost PL tone generator.

by Ray Isenson N6UE

So you've got a problem! Last night the repeater group voted to put your favorite machine on PL, and you don't have a single rig with CTCSS capability. Worse, half of your rigs are so old you couldn't buy a modification kit even if you had the money. The XYL (XYM) hasn't cooled down since you bought that new packet TNC, so there's no way you could come up with the money for a tone board for the fancy all-mode that Santa brought last Christmas!

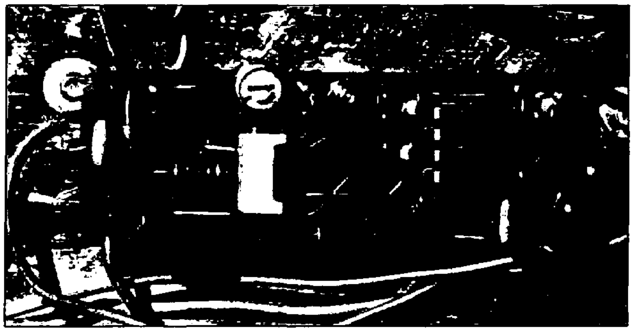


Photo A. The completed PL board.

Uncle Elmer to the Rescue

Actually, if you can squeeze about seven dollars out of the kid's piggy bank; if there's a Radio Shack or its ilk around; if you have a soldering iron; and if you're not above a small challenge, your old Uncle Elmer may have just the solution for you. It should make a good one-evening project.

What is PL?

Some years ago Motorola introduced "private listening (PL)" to the commercial radio community. In one implementation, a tone, generally a subaudible frequency (67–210 Hz), is impressed on the transmitter's carrier along with the audio intelligence. A companion, single-frequency demodulator at the receiver enables the audio circuits only in the presence of this tone. The result is a form of selective calling.

Picture a master station with the ability to switch in any one of a number of different "calling" tones. If there is also a remote receiver for each of these tones, remote stations will hear only those transmissions addressed to each of them. The master station can talk with any secondary station without bothering operators at the other receivers. Additional circuitry maintains the privacy of the return link.

Some members of the amateur community adapted the concept to VHF and UHF radio when repeaters became popular, but not without dissenters. Unfortunately, its early use by amateurs was intended to deny repeater access to nonmembers. Many of us, including myself, believed strongly that this was contrary to the open spirit of amateur radio, and we refused to have anything to do with it. More recently, we've had to reconsider our position, as more amateur and commercial repeaters have taken over the hilltops. Using PL helps combat intermodulation and other interference problems.

How PL Works

In the normal scheme of things, the repeater receives an FM signal and the detected carrier switches in the transmitter through COR, or Carrier Operated Relay. The typical PL operating repeater uses the detected subaudible frequency tone, as opposed to the detected carrier frequency, to pull in the transmit relay. In some cases the operation requires a continuous subaudible tone to maintain contact. In others the tone serves only to pull in the relay; the carrier or some other signal holds it in. In the latter case the system generally will function even if the tone is continuous. To work through the protected machine, we only need to provide a tone at the right frequency and amplitude to

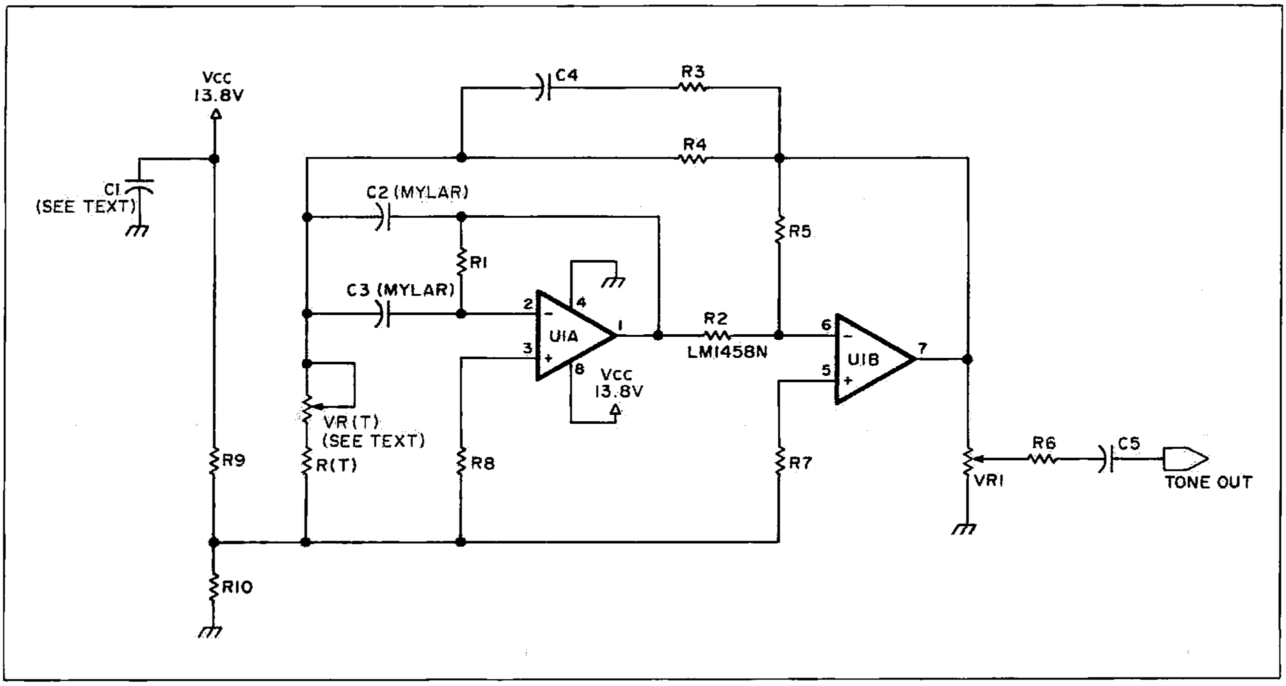


Figure 1. The PL Tone Generator Circuit.

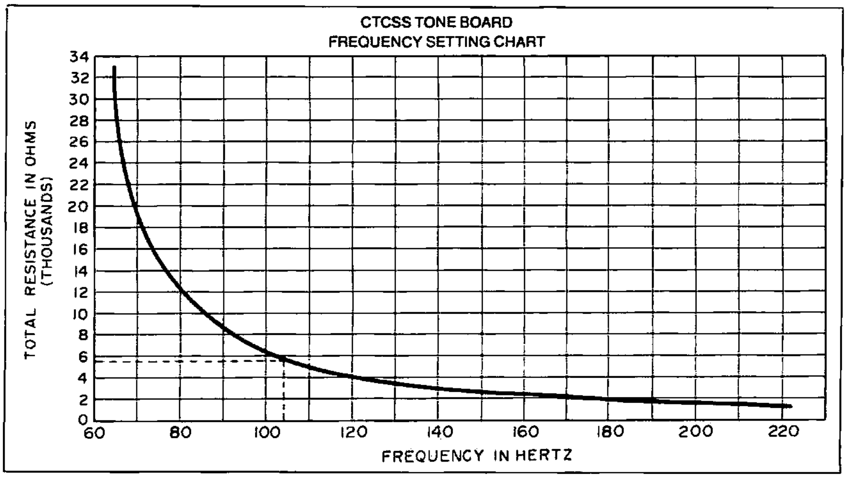


Figure 2. Graph showing tone frequency vs. tuning resistance, to help you choose the right resistance combination for a desired subaudible tone.

satisfy the repeater. Figure 1 is a schematic of a very simple circuit designed to do just that.

Uses Common Parts

There are no high cost or hard-to-find parts in the circuit. Your local electronic parts store is a good source. The total cost for the unit, assuming that you have none of the parts on hand, is less than $7. The only critical parts are C2 and C3, two 0.1 µF Mylar™ capacitors. These must be Mylar, polystyrene, or a similar material, to minimize temperature sensitivity and assure frequency stability. The common RF bypass type disc cap will not work. They are too temperature-sensitive! Although a well-equipped hobbyist could make a custom PC board for the project, the predrilled Multipurpose Board (RS 276-150) for 99¢ is not only adequate, it's probably preferable.

The R(T) and VR(T) resistors connected in series, and the previously noted 0.1 µF capacitors, let you tune to the desired PL frequency. The commonly accepted range of subaudible frequencies extends from 67 Hz to 210 Hz. The unit that you assemble will not be able to tune in this entire range, but it won't need to. The computer or electronics technician will have picked the frequency for your machine. Your board will have to be able to set that frequency to within a Hertz. This circuit offers this capability.

Setting the Right Tone

Examining the circuit diagram, you will notice a resistor identified as R(T); a variable resistor, VR(T); and a 47kΩ resistor between pins 1 and 2 of the dual operational amplifier. The three resistors and the 0.1 µF capacitors are the basic frequency-determining components of the circuit.

To give you the freedom to pick among a wide range of frequencies, and set your machine precisely, the circuit uses the two resistors in series. Your task is to select a fixed resistor of a value yielding a tone in the desired range. The variable resistor is used for fine-tuning.

Figure 2 shows total resistance versus frequency in Hz. The curve was experimentally determined with 1% components as the critical frequency determining elements. Use it to make the initial selection of the fixed resistor, R(T), as you design your CTCSS board.

Why the initial setting? As previously noted, the curve was generated with 1% tolerance components for the 0.1 µF capacitors and the timing resistors; a most unlikely thing to realize. Expect values more like ±5% resistors and capacitors. So we'll select a resistor that is somewhat smaller than the curve calls for, and use the variable resistor, VR(T), to make up the difference and allow for some tuning flexibility. The value of the variable resistor should be slightly greater than the difference between the value of the fixed resistor and the value of the next larger one.

Why not just use a potentiometer in the first place? The smaller the total value of variable resistor, the more precise the setting you can make. The variance in resistance per degree of rotation of the potentiometer is less! Now, if you find that your initial choice won't let you tune *down* to the desired frequency, you can replace the fixed resistor with the next higher value.

With curve-fitting analysis, we find that the Resistance/Frequency curve can be closely approximated by the equation:

$$\text{Frequency} = 3896 \times ((R \times 47000)/(R+47000))^{-0.4222}$$

where R is the sum of the fixed and variable tuning resistors. I note this equation to emphasize that if you replace the feedback resistor across the first part of the dual operational amplifier with something other than the 5%, 47,000Ω device specified, you may not be able to use the curve in Figure 2 to select your tuning resistor. In other words, change that resistor and you're on your own!

Choosing the Resistor Combo

This project was originally undertaken to build PL tone generating boards for members of a 2 meter repeater group in the California Central Coast area. Their repeater was subjected to some intermodulation from two commercial paging service machines situated on the same hilltop. The offending RF frequencies, unfortunately, were exactly 600 kHz apart! These two frequencies, beating with the repeater transmitter output, resulted in an annoying "grunch" at the repeater's input frequency. The trustee demonstrated that the PL technique circumvented the problem, and he opted to put his machine on PL.

He selected a frequency of 103.5 Hz for the PL tone. Using that frequency as an example, and referring to the curve in Figure 2, the vertical dashed line that intersects the abscissa at 103.5 Hz represents the selected design

line. A horizontal line drawn from the intersection of the vertical line and the curve to an intersection with the vertical scale, suggests the need for total timing resistance of approximately 5.5kΩ.

The closest 5%, ¼-watt resistor offered by Radio Shack is 4700Ω. The next higher value of ¼-watt resistor is 10k. The closest variable to the 5.3k unit we need to get the tunability (10–4.7) is Radio Shack's 5k PC board potentiometer. This combination worked well.

If you have access to a more complete selection of electronic components, a 1 or 2k potentiometer and a 5100Ω fixed resistor might be even better for increasing the setting sensitivity. If, because most of your component tolerances stack up on the high side, the highest achievable frequency is just slightly low, shunt the fixed resistor with a large value (perhaps one of the 47k resistors still in the bubble pack). If that doesn't work, you'll have to go to a higher value resistor, but we have not encountered this problem.

From an examination of the curve in Figure 2, it is clear that a significant change in the tuning resistor is needed for a given change in frequency at the lower frequency end of the curve, and a very slight change at the higher frequency end. Because of this, I would be leery of using the circuit for tones above 120 Hz. At that end, even slight temperature variations could throw the circuit outside of the 0.3 to 1.0 Hz tolerance that most PL systems accommodate. The answer is to use a PL tone in the lower end of the band, if possible. In regions subject to wide temperature variations, it would be wise to stay with tones under 100 Hz if you are selecting the PL frequency. The unit in my car operates from the low 30s to slightly over 100 degrees Farenheit. It has never failed to access the repeater. Ambient temperature may never be a problem for you.

In Praise of Predrilled Boards

If this is your first experience with a predrilled board, you're in for a pleasant surprise. Except for the fact that you have to be very careful to avoid solder bridges, predrilled boards simplify small project assembly. Radio Shack offers several variations of these boards. You could use either the RS 276-149 or 276-150 board to make two of these CTCSS tone boards. I prefer the 150 board because it has strings of connected pads to simplify construction. You may prefer the flexibility of the other. For group projects, it'll be cheaper to cut up one of the larger boards into suitably sized pieces.

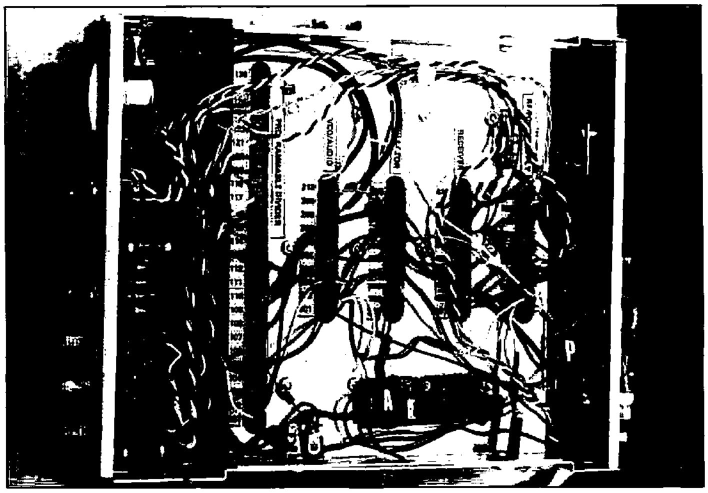


Photo B. The PL board installed in the Conarc 452 2m rig.

Make the board as small as possible, to fit inside the transceiver. The largest components are the potentiometers and the Mylar capacitors. You can get it as small as 0.8 x 1.5 inches. Photo A shows the completed board. You'll find space to mount the unit inside most mobile 2 meter transceivers, but for an HT, you will probably have to resort to external mounting. This has been done without trouble as long as the 0.001 µF RF bypass capacitor was used on the power lead, as shown on the circuit diagram, and all leads were kept short.

Once all of the components are in hand, it's a good idea to make a sketch showing the physical layout. If you use a board with connected pads, such as the RS 276-150, make sure that all items entering or leaving each "node" are connected—even if you have to jumper strips together to do it. If you use the separate pads, as on the RS 276-149, remember that you'll have to "wire" the pads together after soldering the components to the predrilled board. Show these wires on your sketch. (Note: I use very fine wire to connect the pads and create "solder bridges" between those pads that I want to connect.)

Check to make sure that you make all of the connections called for in the schematic. If the circuit doesn't oscillate at the desired frequency, you can bet that the diagram didn't support the circuit. It is a good idea to try a few different layouts to find the one that fits your transceiver the best; it's better to do it at this time than after the board is all made up! Cardboard cutouts are useful for sizing.

As of this writing, the circuit has been used in more than twenty transceivers of many different types. These include the Conarc 452, the Azden PCS 4000, the Kenwood TR-7850, the Heath HW-2036, other Kenwoods, both newer and older than the 2850, several different Midlands, an ICOM 22A, a more recent ICOM, and a few different models made by Yaesu. Other than the difficulty of squeezing the board into a clear place in the cabinet, the only problem we encountered was finding a suitable point to insert the signal.

Having the Right Connections

DO NOT—REPEAT—DO NOT try to insert the tone into the microphone circuit. Signal shaping in that area is almost guaranteed to attenuate and distort the tone to oblivion. User manuals for many fairly new 2 meter rigs suggest a connection point for the PL tone generator. Read your manual before taking someone else's advice!

If the manufacturer didn't offer a solution, use the schematic to locate the deviation adjust potentiometer. Tone input at the tip end (preferably), or center tap of that potentiome-

Continued on page 40

Parts List for the CTCSS Tone Board

Component	Type	Cost
Fixed Resistors ¼-Watt, 5%	R9, R10 1000Ω (Pkg. of 5)	$ .39
	R2, R3	33kΩ@ .39
	R1, R4, R5, R6, R7, R8	47kΩ@ .78
	R(T)	See article@ .39
Mylar Capacitors, 50 WVDC		
	C2, C3	0.1 µF (Pkg. of 2)@ .79
Capacitors, RF bypass		
	C1	0.001 µF@ .49
Potentiometers, ¼-Watt		
	VR1	25Ω@ .59
	VR(T)	See article@ .59
Integrated Circuits		
	U1	LM1458@ .99
Project Board		See article@ .99
TOTAL COST		$6.39

Table 1.

Number 5 on your Feedback card

HAM PROFILES

There are no "average" hams!

Photo A. Diane Magen KG5CS, age fifteen, Hot Springs, Arkansas. Her career plans include aviation, engineering, and mathematics.

Friends the World Over

Diane R. Magen KG5CS is a fifteen-year-old high school sophomore in Hot Springs, Arkansas. In addition to the time she puts in to maintain her "A" average in school, Diane manages to find time to study in ground school for her private pilot's license.

Diane participates in YL contests and enjoys the security of a 2 meter rig in the family car. Other interests include baton twirling, needlepoint, and traveling.

Writes Diane, "No matter where you travel, you always have friends. Amateur radio is a wonderful fraternity!" She had a wonderful opportunity last summer to meet face to face some distant acquaintances made over the air. She and her mother (also a ham) travelled aboard the *Ocean Pearl*, which sailed to Singapore, Borobudur and Bali, Indonesia, Manila, and Canton. During this trip, they met with Roger DU1KT, Phil VS6CT, and Ian G4LJF. By the time you read this, Diane KG5CS will have explored Monaco, Florence, Rome, Venice, the Lipari Islands, Corfu Island, Dubrovnik, Yugoslavia, and Paris. She will also have visited Vince Sullivan N2UN at the United Nations.

This coming school year, Diane KG5CS hopes to work as a page in the House of Representatives.

Meet Another Southern Belle!

Be sure also to get in touch with Dorothy Livsay KC4IQP when you're travelling through eastern North Carolina. This thirteen-year-old spends a lot of time working CW on two 220 repeaters, NF4C and WA4DAN. She is a very active and enthusiastic ham.

Photo B. Dorothy Clark KC41QP, thirteen years old, is an active 220 MHz FMer.

Dorothy KC4IQP and her father studied amateur radio together and became licensed at the same time. This month, they plan to upgrade to General. Their Elmer, who sent us Dorothy's photo, prefers to remain anonymous, but has been a ham for fifty-five years.

In addition to amateur radio, Dorothy KC4IQP enjoys music and softball. Her current ambition is to attend the Coast Guard Academy. 73

To obtain guidelines for submitting Ham Profiles, write or call Joyce at 603-525-4201 Ex. 551, or download them from the 73 BBS/73mag SIG. (PH: 603-525-4438, 8 data bits, no parity, one stop bit).

FEEDBACK

In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers, which appear on each article/column and are also listed here. These numbers correspond to those on the feedback card opposite this page. On the card, please check the box which honestly represents your opinion of each article or column.

Do we really read the feedback cards? You bet! The results are tabulated each month, and the editors take a good, hard look at what you do and don't like. To show our appreciation, we draw one feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*.

To save on postage, why not fill out the Product Report card and the Feedback card and put them in an envelope? Toss in a damning or praising letter to the editor while you're at it. You can also enter your QSL in our QSL of the Month contest. All for the low, low price of 25 cents!

73 Review *by Brian Lloyd WB6RQN*

Kantronics KAM

Versatile multi-mode data controller.

Kantronics, Inc.
1202 E. 23rd Street
Lawrence KS 66046
(913) 842-7745
Price Class: $320

The Kantronics KAM is an all-mode computerized Interface that will send and receive CW, packet, RTTY, ASCII, and AMTOR. The KAM can be used with a personal computer to receive weather facsimile (WEFAX) broadcasts.

The Hardware

The KAM is a modem-sized box, 22.5 x 14.7 x 4.7 cm. The front panel has two push-button controls, one for power and one to select the FM or AM (limiter-less) operation of the HF modem. The rest of the front-panel controls are all LED status indicators, plus an easy-to-read green bar graph tuning indicator. The back panel has two radio connectors, a connector for the computer or terminal, and a connector for power.

The KAM operates at 12VDC at 260mA. The power connector is standard coaxial, like that found with most small radios and accessories today. Kantronics provides a small 12VDC at 300mA power cube with the KAM. The low-power 12 volt operation makes the KAM a natural for portable or mobile operation. You have the options of providing operating power on one of the pins of the computer interface connector, or on the VHF radio connector, to reduce the number of cables.

The unit connects to your computer or terminal with a standard RS-232 DB-25 connector. This connector is factory configured for a standard RS-232 DCE (modem) connection. This means that you can probably unplug the modem from your computer and plug the KAM in its place with no other wiring changes. The KAM computer interface supports all the standard modem signals, so your terminal program may be used without modification. Alternatively, you may choose to use Kantronics' terminal program called "Kanterm" (I did—more on this later).

If your computer does not support RS-232 signals (the Commodore 64 and VIC-20 immediately come to mind) you will want to open the KAM and change jumper K7. This changes the controller output to the computer to TTL.

A word of warning: Pin 25 of the computer connector is "hot" with 12VDC. Make sure that pin 25 of the computer interface is not inadvertently grounded through the computer. Damage to the KAM and/or the computer could result. Play it safe and use an RS-232 cable that does not provide a connection to pin 25.

There are two radio connectors: one for HF and one for VHF packet. The HF port is an 8-pin female DIN jack. CW, RTTY, AMTOR, and low-speed (300 baud) packet are supported from this connector. The VHF port is a DB-9 female connector identical to the radio ports

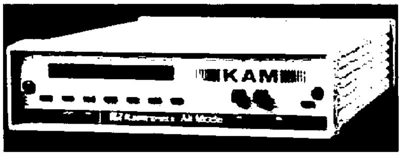


Photo A. The Kantronics KAM—a multi-mode data controller.

on the KPC-2, the KPC-4, and the KPC-2400. If you have one of these other Kantronics products you can use the radio cable interchangeably with the KAM. The VHF connector on the KAM supports 1200 baud VHF packet only.

The Manual

With a device this complex (the KAM can do a great deal) the manual is VERY important. Almost nothing about the KAM is intuitive (although it will be very familiar to anyone who has used TNCs before). The manual is complete, albeit somewhat terse. Everything you need to know is in there, but you might miss it if you do not read carefully. I strongly recommend that you read the manual, especially the part about interfacing the radios and the computer, from beginning to end before you attempt to connect and use the KAM.

There are MANY commands for controlling the KAM (I counted 165). The manual does a reasonably good job of covering the most important commands and walking you through getting the KAM operating. I read the section describing all the commands before I tried operating because there are some differences between the KAM command set and the common TNC command set.

The only section of the manual I found at all difficult to understand was the section on multiple connections (being connected to more than one other station concurrently). I cannot really blame Kantronics for the confusion. Kantronics chose to be compatible with the multiple connect format used in the TAPR TNC. I find this format is awkward to use. The KAM manual does as good a job of explaining the convolutions of multiple connections as I have seen anywhere. (This is one of the reasons that I have personally switched to using the KA9Q TCP/IP packet program for my packet operations. With KA9Q TCP the computer does all the work keeping the sessions separate, and I don't have to worry about it.)

Connecting the Computer

The first step in getting the KAM to operate was to establish communications between it and the computer or terminal. I started out using both my standard terminal program and the Kantronics-provided Kanterm program. I finally settled on Kanterm since I liked the split screen display with separate windows for data received on the HF port, data received on the VHF port, and keyboard data. Kanterm does a good job of formatting the screen and keeping things visually separate without hiding the actual exchange of commands.

My only complaint about Kanterm it is that it erases the content of the windows if you change the window format (if you change from horizontal to vertical windows, from one to two windows, etc.). The information that was contained in the windows however, is not lost. It can be retrieved with the scrollback function.

I did have one technical problem with Kanterm (the PC version). Kanterm did not work with either of my computers the first time, although my terminal programs, Bitcom and Procomm, worked just fine. The problem turned out to be the cable between the KAM and the computer. It seems that some of the RS-232 control signals are not asserted by the KAM, and Kanterm can't or won't initialize the RS-232 port. The fix was to use the "three-wire" RS-232 cable described in the KAM manual, and to add the jumpers on the computer side of the cable (connect pin 4 to pin 5 and connect together pins 6, 8, and 20). This solved the problem and allowed Kanterm to run normally.

I spent plenty of time properly interfacing the radios to the KAM. A quick and dirty interfacing job is liable to lead to poor performance because neither the radio nor the KAM are likely to see the proper signal levels.

VHF Port Connections

This is straightforward, since there are only four signals you need to worry about: audio out (to the mike input on the radio), audio in (from the speaker), push-to-talk, and ground. There is an optional external carrier detect signal, but that is very rarely used. Since I already have a KPC-2 connected to my 2m rig (an ICOM IC-245) I used its cable to connect the KAM.

It's very important to set the signal level from the KAM to provide 3 kHz deviation of the VHF FM transmitter. There is a problem doing this because the KAM provides only three jumper-selected choices for output level: low, high, and much too high. I had to change the value of one of the resistors on the circuit board (R-12) to get the proper level for my transceiver. Fortunately, the manual clearly describes the procedure. This was not a problem for me because I am comfortable using a soldering iron to make changes to a circuit board. Still, it would have been much nicer if Kantronics had provided a pot for output level adjustment.

The manual indicates that the VHF modem is sensitive to input level. Kantronics suggests a maximum input of 50 mV to the KAM. The easy way to set this is to hook the KAM's VHF audio input to the speaker of the transceiver and then adjust the volume control for 50 mV while receiving packets.

A nice feature of the KAM is that it allows the user to select from three different receive equalization settings (jumper K-1). With my configuration, the TNC and/or KAM connected to the discriminator through a buffer, I found that the position that disabled equalization provided the best results. Connecting the KAM to the speaker jack would probably have required partial or full equalization. The KAM is shipped with jumper K-1 set to the full EQ position.

HF Port Connections

For this, you have to build your own cable. The HF connector on the KAM supports the following signals: audio in (from the speaker or phone patch output of the rig), audio out (to the mike or aux audio input of the rig), key out (to the CW key jack on the rig), FSK out (to the FSK input on the rig), PTT out (the PTT line on the rig), external carrier detect (from the squelch on the rig), and ground. I tested the KAM with a Kenwood TS-940S transceiver and most of the connections went to the accessory jack on the back of the transceiver. The two exceptions were the key and the FSK signals. I had to run those signals to separate plugs.

Setting the level for AFSK operation was much easier. Most HF rigs allow you to set transmit levels from the front panel, usually with the mike gain control. Use jumper K-5 (HF AFSK output) to select the lowest output from the KAM that will provide full output from the rig. Most rigs include instructions for connecting RTTY equipment; follow them.

VHF Packet Operation

After I got my computer, Kanterm, KAM, and my radio all talking to one another I decided to try the KAM out on VHF packet. If you have used a TNC before, nothing could be simpler. The commands are all familiar and work in a similar manner. The KAM performs as well as any other TNC I have used on VHF packet.

Kantronics has added a few commands that have the potential to make packet operation more effective. In addition to the DWAIT command (used to prevent collisions between packets from end-user stations and digipeaters), Kantronics added the PERSIST and SLOTTIME commands. These two commands implement something call p-persistent CSMA which promotes better channel sharing amongst the users. Users in your area will notice an improvement in throughput and a reduction in retransmissions as more stations begin using p-persistent CSMA.

After I used the KAM to check into the bulletin board and have a OSO or two, I tried it out with TCP/IP, my usual packet operating mode. The KISS mode worked just fine. I transferred a couple of files and several mail messages, and had a QSO, all at the same time.

HF Operations

The KAM is as good on VHF as any TNC, but the reason to buy it is to get the HF packet, RTTY, AMTOR, and CW capability. Any discussion of these modes requires a discussion of the design features that make them possible.

One of the keys to the flexibility of the KAM is the programmable HF modem. The modem can be programmed for just about any baud rate (up to 500) and any two tones. When you select RTTY, HF packet, ASCII, AMTOR, or CW, the KAM automatically chooses the standard modem settings used with that mode. If you wish, you may change the baud rate, the mark, or the space tones. This can be a real boon to experimenters. You can also optimize the tones to your particular rig.

A switch on the front panel of the KAM selects either FM (limiter) or AM (limiter-less) operation of the demodulator. I noticed a small but discernible performance difference between the two modes. The AM mode seems to have the edge on weaker signals, while the FM mode seems to have the edge on stronger signals when QRM is present. It is nice to be able to choose between the two.

Tuning Indicator

This is part of the HF modem and is used as an aid to tuning RTTY, ASCII, AMTOR, Packet, WEFAX, and CW. The green bar graph display is labeled with mark and space at opposite ends. If you have selected the proper shift and tuned the signal properly, the bar extends fully from the center to both ends.

The tuning indication on CW is slightly different. When no signal is present the bar graph segment nearest the left (mark) will be lit. When the other station is key down, the segment nearest the right (space) should be lit. Tune slowly until this occurs.

CW Operation

The first HF mode I tried was CW operation. Here, the KAM allows you to independently select filter bandwidth (the standard is 200 Hz, but it may vary from 50 to 1000 Hz), and the filter center frequency. The KAM keys the transmitter using a reed relay so it can work with relatively high voltage grid-block keying circuits. Using a relay also ensures that polarity is not a problem.

The manual claims that the KAM can automatically track CW sent at speeds up to 20 WPM different from the value set with the CW or CWSPEED commands. This means that you can set it for 20 WPM and the KAM will lock and track just about anything between 0 and 40 WPM. From what I could tell it did. Although the KAM will track any speed, the KAM sends CW at the speed set by the CW or CWSPEED commands. This means that you have to guess how fast the other guy is sending and set the KAM appropriately.

The KAM did a good job of copying a good fist or machine-sent code. It pretty much falls apart trying to copy a poor fist. The KAM is also picky about inter-character spacing. If the sender sends the characters at a faster rate but then inserts more time between characters the KAM will display the characters separated by spaces (as if each character is a separate word). It is readable but annoying. If you are copying someone with a keyboard or using a keyer, the copy is flawless. I found it great fun to copy the high-speed maritime CW transmissions.

Once you have selected the CW mode the KAM tries to copy everything. Pressing "control-C" followed by "T" (^CT) enables the keyboard, and everything you type will be sent. Pressing "control-C" followed by "R" (^CR) returns the KAM to the receive mode.

Several keyboard keys are mapped to produce special Morse symbols such as AR, BT, AS, KA, SK, KN, AA, and SN. It takes a little getting used to. I solved the problem by making small adhesive labels and attaching them to the computer's keyboard.

RTTY and ASCII

RTTY and ASCII are both character asynchronous data transmission. Their sole difference is that RTTY uses the 5-bit Baudot code and ASCII uses the 7-bit ASCII code. I didn't test sending and receiving ASCII because I never found anyone else using ASCII. Since there is no other difference between RTTY and ASCII operation, I expect that my comments about RTTY will apply to ASCII as well.

Receiving RTTY is simple. Just select the shift and the baud rate, then tune the receiver for the proper indication on the bar graph tuning indicator. The tuning indicator also makes it obvious if you select the wrong shift. On the ham bands I found 45 baud (60 WPM) with 170 Hz shift to be the rule. Tuning was simple and I could copy almost anything.

How you choose to send RTTY depends on your rig. Most SSB rigs do not have a special RTTY mode so you must use AFSK. The tones from the KAM are fed into the transmitter and the transmitter is operated on lower sideband. If your rig supports direct FSK (the TS-940S does) you can use that mode, but you lose the ability to select transmit shift from the computer. I tried both methods and they worked equally well.

One activity I particularly enjoyed was trying to copy commercial and private RTTY transmissions. In this game you tune in a transmission and try to decode it. It's easy to change shift, baud rate, and inversion "on the fly." This activity is more difficult now because few of the commercial transmissions use character asynchronous clear-text transmission; most now use some transmission mode that is indecipherable by the KAM.

AMTOR

After becoming comfortable with RTTY operation I decided to try my hand at AMTOR, a mode I have never used before. Before I could operate AMTOR I needed to understand some concepts.

AMTOR is like a cross between RTTY and packet radio operation. Data is transmitted in three character "packets," using an error detection code. In this way, AMTOR is like packet radio. On the other hand, AMTOR is like RTTY because it uses the similar speeds and

shifts, and only one pair of stations at a time can use a given frequency.

Each AMTOR station on a frequency must have its own unique identification (SELCAL). The SELCAL is a 4-character identifier used to call and establish communications with another station. To save you time the KAM automatically creates a SELCAL entry from your callsign. In my case my call, WB6RQN, was permuted into WRQN for the SELCAL. The KAM provides the option to manually enter the SELCAL of your own choice.

To get started with AMTOR I used the LAMTOR (Listen AMTOR) command to "eavesdrop" on other AMTOR and commercial SITOR transmissions. This gave me practice in recognizing and tuning AMTOR signals. The KAM copied these signals well, with only an occasional lost or duplicated "packet" (duplicated when the receiving station requested retransmission of a packet). Copy of transmissions using the Forward Error Correction (FEC) mode B was almost always 100%.

Active contacts require a special protocol because AMTOR is designed as a reliable station-to-station mode of operation. Most AMTOR QSOs use the Automatic Request for Retransmission (ARQ), Mode A. This requires that the two stations "handshake" (the receiving station must "ACK" each transmitted packet). This makes calling CQ an interesting prospect.

To call CQ with the KAM, you enter AMTOR mode with the AMTOR command and do not specify a SELCAL. This places the KAM in standby mode (ready to receive). Key the transmitter with the control-C T (^CT) command (same as with CW and RTTY) and type a standard 3 x 3 call making sure to include your SELCAL. End the CQ with the control-C R command (^CR). If someone else wants to respond they will zero-beat your CQ and then call you using your SELCAL. The KAM recognizes your SELCAL and begins the handshaking process with the other station.

The link is turned around with the character combination "+?". This tells both the KAM and the other station that you want to turn the link around so the other station can send (this is equivalent to the word "over" in voice communications). When you are done with a QSO and wish to break the link you enter the sequence control-C X (^CX). You have the option of "breaking" the other station when he/she is sending by entering the ^CT command. This forces link turnaround immediately.

I had absolutely no problem getting the KAM's AMTOR to work with the TS-940S. If you have problems getting AMTOR to work I would suspect the rig before I would suspect the KAM. AMTOR places significant stress on the rig because it is constantly switching from receive to transmit and back again several times a second. Some rigs just can't switch fast enough. A good thing to look for in a rig for AMTOR is full QSK capability in CW. That indicates that the rig is designed to switch rapidly from receive to transmit and back again. The TXDAMTOR (transmit delay AMTOR) command allows some adjustment for rigs that are slow to switch.

One other significant point in AMTOR's favor is that it does not require massive amounts of power to be successful. For this reason I imagine that most stations run barefoot. An amplifier just adds to the transmit delay and may even make it impossible to establish an AMTOR connection. Even with significant amounts of QRM or QRN, the KAM seems to be able to slip the data through.

HF Packet

The big feature of the KAM for me is its HF packet radio capability. After trying out RTTY and AMTOR, I felt very comfortable with the computer/rig/KAM combination.

The default values for packet operation work pretty well with one exception; Kantronics selected the default value for MAXFRAME to be 128 octets (bytes or characters). This is much too long for HF packet. I shortened it to 32 octets and operated that way.

I had absolutely no problem running HF packet. The KAM automatically selected 200 Hz shift (1600/1800 Hz tones) and 300 baud. I used lower sideband and AFSK operation without any problems. Setting the receiver's bandpass to 500 Hz seemed just about optimum. In sum: It works well and was easy to set up.

WEFAX

The last mode offered by the KAM is the ability to receive weather facsimile (WEFAX) broadcasts. For this mode the KAM operates strictly as a WEFAX modem. The actual processing of WEFAX pictures takes place within the computer.

There is a surprise in store for you when you try to use the KAM to receive WEFAX: The signal must be connected to the VHF port! You may wonder about this after you took all the trouble to hook your HF receiver to the HF port, but that's the way it is. Perhaps a switchbox to allow switching the receiver to either the HF or the VHF port is in order.

Kantronics supplies two WEFAX programs for use with the KAM and a PC: MaxFAX and SuperFAX. I started out using the MaxFAX program, but wasn't pleased with its performance. On my computer with a CGA graphics adaptor the FAX pictures were jumbled on the CRT display but printed properly on the printer. My other complaint was that MaxFAX lacks any onscreen key labeling or help.

The SuperFAX program is MUCH better. I found it to be much more "friendly." SuperFAX also properly displayed the pictures on the CRT display. SuperFAX is larger and slower than MaxFAX, but that is a very small price to pay for the much improved performance.

There is another feature of SuperFAX that I like very much; it comes with the source code to the program (it is written in BASIC). This should make it possible to make changes or to move the program to another computer without too much difficulty. I would like to see more vendors do this.

Special Packet Features

The KAM comes equipped with two special packet features not found in most other TNCs or multi-modes: a gateway function and a personal packet mailbox. The gateway function permits the KAM to act as a crossband digipeater when both the HF and VHF ports are enabled. This means that packets may be picked up from the HF channel and digipeated on the VHF channel, and vice versa.

To make the gateway work you must enter a different ID for the gateway. My ID (call) is WB6RQN-0 for local HF and VHF operations, and WB6RQN-1 for the gateway. Packets that arrive on VHF to be digipeated by WB6RQN-0 are retransmitted on the VHF channel. Packets that arrive on the VHF channel to be digipeated by WB6RQN-1 are retransmitted on the HF channel. Likewise, packets that arrive on the HF channel to be digipeated by WB6RQN-1 are retransmitted on the VHF channel.

I think that the gateway feature is a big plus. I expect it to be a very useful feature if and when we are granted permission by the FCC for unattended operation of HF packet stations. Presently, you must be in the shack whenever the gateway is enabled.

The second function is the personal packet mailbox (PPM). This permits people or BBS stations to connect to the KAM and leave or retrieve messages. In essence the KAM becomes a small BBS with messages stored in the KAM's memory rather than on a disk.

I do not expect the PPM to replace any BBSs but I do think that it can become a big part of the local BBS operation. One of my big complaints with BBSs is that you have to periodically check into them to see if you have received any messages. If there are many BBS users in your area this can become a painful process with several people trying to access the BBS and/or keeping it tied up for long periods of time. PPM can help alleviate this problem by allowing the BBS to automatically forward your mail to the KAM-running PPM. All you need to do then is to check the KAM for your mail. Sending mail works the same way: You prepare the mail in the KAM and let PPM automatically forward your mail to the BBS.

The concept is very good. PPM performs as advertised. The only problem is that the KAM's memory is limited so you can not have many large messages stored. PPM, however, has the potential to significantly reduce BBS overload if people make use of it.

Final Impressions

The KAM has performed flawlessly for me for the six months or so that I have used it. After this much use I can safely say that the KAM is a very impressive product. It does everything that it is advertised to do, and does it well. For relatively little money Kantronics has provided a great deal of functionality in a very small package. From this point of view the KAM may be the ultimate station accessory.

If you are looking for a small, low-power, lightweight, all-purpose terminal unit to use with your personal computer, the KAM may be the answer. Ditto, if you are tired of just rag-chewing on HF and want to do something really different. I recommend the KAM without any reservation. 73

COCOA—A COllinear COaxial Array

Make COCOA your cup of tea.

by James E. Taylor W2OZH

Since 1970, I have used a straightforward, phased array for 75m. This array is composed of two parallel dipoles a quarter-wavelength apart, with a ganged switch to control directivity by changing the lengths of the coaxial feedlines to the separate dipoles.[1,2]

A Few Improvement Ideas

Although I've had great results from this system, old-fashioned ham curiosity led to several improvement attempts. I first looked at two-phased verticals.[3] These vertical radiators were a quarter-wavelength high and apart, and ultimately, each included 73 quarter-wave radials. Although electrically excellent, they never showed a consistent advantage over the horizontal system over several years of use, in spite of published material to the contrary. It's likely the far-field ground losses at my location cancelled the vaunted low-angle advantages.

I then looked at using three half-wavelengths of coaxial cable, with inner and outer conductors interchanged, to provide a collinear in-phase array. Balsley and Ecklund used such a scheme for a radar system at 49.8 MHz.[4] However, space and height limitations made this system impractical on 75 meters. What to do?

Bnild On the Original

Challenged by the above experiences, and by an ignorance of limiting factors such as ground losses, I went back to my 2-element array to try to build on that.

Recall that this system comprises two parallel half-wave elements positioned one quarter-wavelength apart. The center feedpoint of each element is supported a quarter-wavelength above the ground. One way to improve this system would be to add a half-wavelength element, collinearly, to each end of the two radiators, yielding a total of six half-wave elements! Such prospects led to a summer of exciting experimentation. This article describes the results of my summer fun!

This article is in two parts. First, I describe the 3-element in-phase radiator (COCOA-3) and its extension to a 6-element phased array (COCOA-6). I then cover the shortened, more limited configuration I used for experimentation.

The Collinear-Coaxial Concept

Antenna handbooks commonly show a collinear antenna comprising three half-waves in phase. They usually show a centerfed flat-top, three half-waves long. In the standard configuration (Figure 1), phase reversing stubs, added at the ends of a centerfed dipole, put the instantaneous RF current in the end elements in phase with that in the center element. You can make these phase reversing stubs from open wire line or coaxial cable. Normally, a shorted quarter-wave stub is used, but an open-ended half-wave stub would work just as well. The problem here, though, is that the dangling stubs are unwieldy at the lower frequencies.

COCOA-3

We can replace the dangling stubs with something sturdier and more compact. See the basic shorted quarter-wavelength of coaxial cable, shown in Figure 2. When you apply an RF voltage of phase angle P' to the center conductor A at the open end, the stub causes a voltage phase lag of $P' - 180°$ at the adjacent coax shield. Why this happens is easy to see.

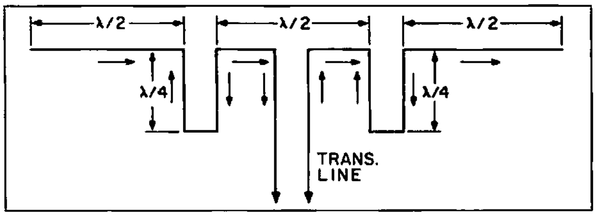


Figure 1. Three half-wave sections phased using "dangling stubs."

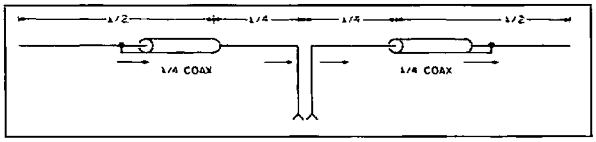


Figure 2. Horizontal quarter-wave stub. It replaces the dangling stub and is less unwieldy and sturdier.

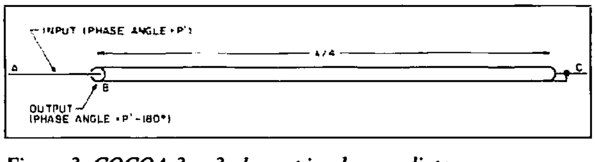


Figure 3. COCOA-3, a 3-element in-phase radiator.

The RF is delayed by one quarter-cycle as it passes from left to right, from A, inside the coax, to the shorted end. There's another quarter-cycle delay as the wave passes back from right to left inside the coax and emerges on the shield at B. Add up the delays and you get a total time delay of one-half cycle, or 180°.

RF energy can also readily turn corners if a lower impedance beckons. Thus, we further expect the RF wave to continue travelling to the right, along the outside of the coaxial shield, arriving at C. The setup shown in Figure 3 replaces that in Figure 1. In Figure 3, the stubs are horizontal. They perform the desired phase reversal while providing part of the added half-wave radiators with the outsides of their shields. You need only add enough wire at the ends to complete the COCOA-3 radiators. (See construction details below.)

Six-Element Phased Array (COCOA-6)

For a given power level, the current at the feedpoint of the COCOA-3 radiator is lower than that for the simple dipole radiator, so the input resistance in this case is higher. Add a toroidal transformer at the COCOA-3 input to decrease this value to 50Ω. If possible, put the matching transformer at the top of the mast that supports the radiator center.

Once the impedance is matched to 50Ω, you can excite the two COCOA-3 radiators. The phasing can be controlled by a switching network, as in the 2-element phased array. Figure 4 shows the COCOA-6 arrangement with nominal lengths for 3.955 MHz. I measured these lengths electrically, using a noise bridge to assure precise matching.

Keep'em High

Each COCOA-3 radiator is approximately 354 feet long (noise-bridge measurements determine the exact dimensions). For lower frequency bands, it's very important to place all radiating elements as high as possible above ground, since ground penetration greatly reduces radiation efficiency. If possible, support all three COCOA-3 elements no less than 40

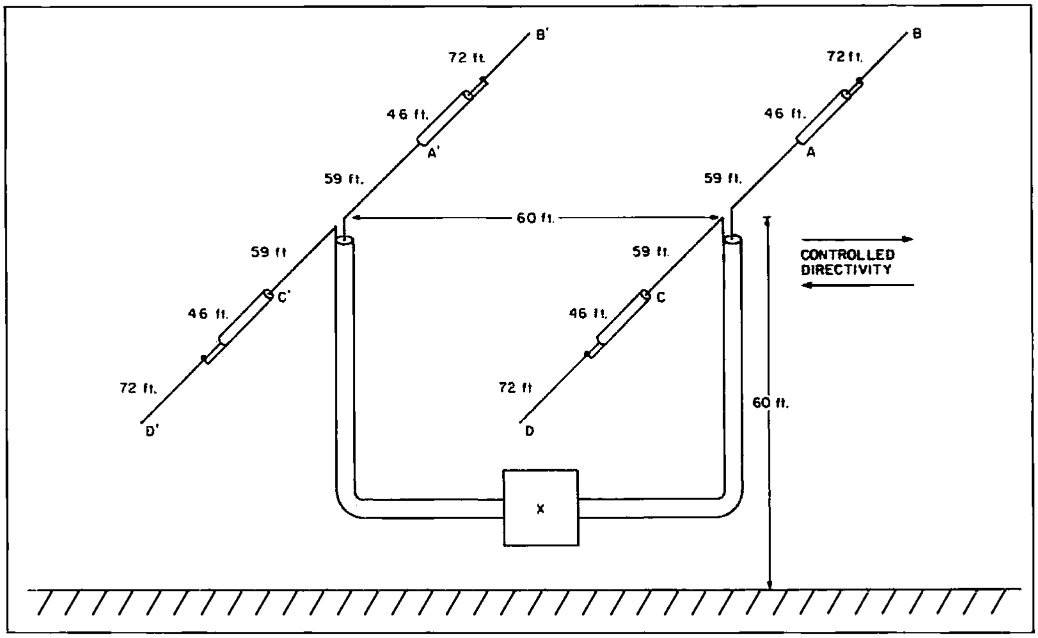


Figure 4. The COCOA-6, a 6-element phased array. "X" is the direction-switching manifold. Lengths shown are nominal values for 3.955 MHz.

feet above ground. They work best at one quarter-wavelength (about 60 feet) above ground.

The center masts at W2OZH proved practical over the years. I briefly describe their arrangement here. (See Reference 1 for more details.) Each mast is made from three 20-foot lengths of 2-inch outer diameter (o.d.) aluminum irrigation pipe, spliced end-to-end. Place the bottom half of each mast coaxially inside a 30-foot length of 3-inch o.d. pipe for added strength. Use quarter-inch crossed bolts to complete the mast assembly. Pivot the assembly on a 1-foot high, 2-inch diameter post, anchored in concrete in the ground.

The aluminum's light weight and the stiffening effect of the double pipe make for easy erection. After erection, bolt the masts to the roof structure at about 18 feet above the ground, and guy wire them in four directions at about 40 feet, as well as at the top. The center radiator wires guy the mast at the top in two of the four directions.

Pass the coaxial feedline (RG-213/U) up through the masts to the top insulator assembly. This assembly is a 6-inch length of capped PVC pipe, 2-inch i.d., that contains a balun transformer. Firmly anchor the feedline here, and pot the assembly in automotive grade epoxy.

Phase Reversing Stubs

The center radiators extend about 59 feet to either side of the center masts. Use seven strands of #22 copper-clad wire. After final measurements, paint them with polyurethane varnish to resist rust. Type RG-8 Mini-Foam coax works well here because it's light and convenient to handle. Make sure the coax terminals are mechanically secure, and that you've put a good moisture seal on them. Figure 5 shows this in detail. Seal both ends of the coax after trimming it to precisely one quarter-wavelength. The spade lugs are convenient for disconnecting the end sections of the COCOA-3 during resonance measurements.

Measurements and Adjustments—COCOA-6

You need to adjust the electrical length of each phase reversing stub on the ground, before assembly, using a noise bridge. The impedance-transforming properties of a quarter-wavelength of coax are such that, if the far end is an open circuit, the impedance at the near end is essentially zero. Connect the noise bridge with short leads to one end of a 47-foot length of RG-8 Mini-Foam coax, and trim the other end until the null corresponds precisely to the desired frequency. In this article, I use 3.955 MHz. Then assemble and seal both ends, as Figure 5 shows.

Let's assume we are adjusting the full 6-element array (The procedure for adjusting a single, 3-element array is identical, except you don't have to consider the second fed radiator.) You adjust the three elements of the COCOA-3 sequentially by noise bridge measurement, beginning with the center element. Before measuring the antennas, trim the two feedlines so that the electrical length of each is an integral multiple of one half-wavelength (in the coax) for the frequency used. This assures that the impedance of the antenna feedpoint is measured accurately by the noise bridge. In my case, each feedline is two half-wavelengths long at 3.955 MHz, measured and trimmed in a like way as for the phase reversing stubs.

Again refer to Figure 4. To adjust the antennas, open the spade lugs (which connect the end elements to the center elements of both COCOA-3s) at *A*, *A'*, *C*, and *C'*, and pull the antennas up to their final positions. To allow for the mutual impedance effect between the two antennas, terminate the feedpoint of the non-adjusted "antenna" with a 50Ω, 1 Watt carbon resistor. The noise bridge null now measures the input resistance as approximately 50Ω at the resonant frequency of this dipole antenna. Adjust the lengths of the wires equally, at points *A* and *C* until you reach the desired frequency. Then shift the resistor to the newly-adjusted antenna and trim the second dipole to resonance in the same manner. These two dipoles now make up a 2-element phased array. The gain, compared to a dipole, is approximately 4 dB. The front-to-back ratio varies, typically from 3 dB to as much as 30 dB, depending upon propagation conditions.

End Element Radiator Adjustment

You can still terminate the feedline of the antenna you are not adjusting with a 50Ω resistor, even though the feedpoint resistance is now somewhat higher. Connect the spade lug at *A* on the side which goes to the feedline's *center conductor*. Point *C*, on the side going to the shield, remains open during the resonating of the opposite end element. Connect the noise bridge at the input end of the feedline to see the resonance of the 2-element (COCOA-2) antenna—two half-waves in phase. Trim the element at *B* until you get the desired resonant frequency. The measured input resistance will be somewhat higher than for the dipole, about 60–70Ω. Next, shift the resistive termination to the feedline of the COCOA-2 just adjusted, and adjust the resonance of the other antenna in a similar manner by trimming at *B'*. Check and readjust, if necessary, the first antenna.

The two antennas just adjusted make up a 4-element phased array, the COCOA-4. There's a slight mismatch because the input resistances are no longer 50Ω. This results in a small phasing error, but you can compensate for this by using two toroidal matching transformers (see below and Figure 9).

Adjust the remaining two elements, *C-D* and *C'-D'*, in the same fashion. The spade lugs at *A* and *A'* remain connected, and those at *C* and *C'* will now be connected. Trim the ends at *D* and *D'* to resonate the two COCOA-3 radiators, just as the COCOA-2 antennas were adjusted. Here, the input resistance will be from 100–120Ω, so the

continued on p. 54

73 Review

by Alan C. Merrill W1FYR

Ameritron AL-80A Linear Amp

A reliable 1kW amp at a bargain price.

Ameritron, Inc.
2375 Dorr Street
Toledo OH 43607
Phone: (601) 323-9715
Technical Inquiries: (419) 531-3024
Price Class: $995

Ever tried to work a rare DX station, and have him tell you that he just couldn't pull you out of the mud? Then the big guns opened up, and you were gone.

Ever tried to get a piece of priority traffic through when the receiving station couldn't pull you out of the slop, and there was no one around to relay?

Ever try to call the net up when only half the members could hear you?

Ever get on a frequency during a contest and after a few nice contacts, have another station "steal" your spot because he didn't even know you were there?

Ever get on 75 after a solar flare and try to keep your schedule with the gang, only to realize that you are just barely hearing them, but not vice-versa?

If so, sounds like you need an amp!

Many times, in a marginal copy situation, the extra 10 dB of a linear amplifier will make all the difference in the world. My hat is off to the QRP gang. I greatly admire those devotees, but there are times when an amp may well be the answer to a ham's prayers. To be legal as well as courteous, I always try to make it with the exciter alone. But it is also nice to be able to hit a switch and add another 10 dB to your signal. So often in handling traffic I have been told, "Sorry, Alan, you are not strong enough for me to copy traffic." After hitting the switch, it changes to "Loud and clear—send your traffic." It certainly beats QSP.

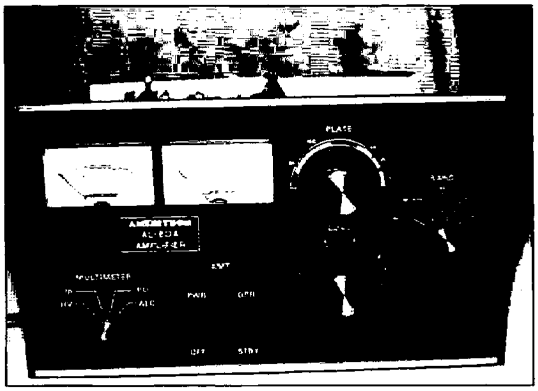


Photo A. The front panel of the AL-80A, showing controls, illuminated multimeter, and grid meter.

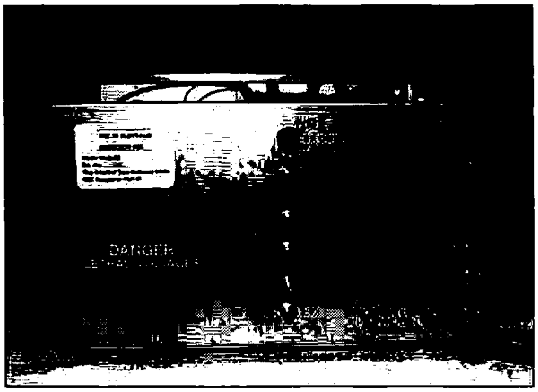


Photo B. Rear panel, showing the SO-239 connectors, phono plug connectors for RELAY, ALC OUT, and 12 VOLTS. Also visible are the ALC adjustment pot and dual fuses on the AC line.

Desirable Features in an Amplifier

There are a number of nice HF linear amplifiers available today, both in kit form and fully built, and they range in price from a low of $600 to a high of better than $4000.

I was looking for an amp that had a respectable output, not necessarily the legal limit; would cover all bands including WARC; was well-constructed; used a tried and true relatively inexpensive tube or tubes; had a relatively small footprint; had a provision for QSK (full break-in) that would work on AMTOR; used a time-proven design; and lastly, would not cost me the proverbial arm and a leg.

The more I looked, the better I liked what I saw in the Ameritron AL-80A. It met all my criteria, and then some. Although the AL-80A is not a QSK machine in its basic form, Ameritron makes a Pin 5 board you can add in the field. It switches fast enough for AMTOR. It all looked good, so I counted out a bit of the coin of the realm, and bought one. It was a good choice!

AL-80A Specifications

The AL-80A is the second step up, power-wise, in the Ameritron series of amps. The smallest one, the AL-84, is a 400 Watt CW, 600 Watt PEP SSB unit.

The AL-80A is a nicely designed amplifier, using a tried and true single 3-500Z high mu triode, running in class AB2 grounded grid. The 3-500Z is not a cheap tube, but on the other hand, if you ever have to replace one, it will not break the bank. Ameritron claims an RF output of 1000 Watts PEP SSB and 850 Watts CW. My experience with the amp showed that both output figures were easily reached, with Bird and Heath wattmeters to tell the story. I run a lot of RTTY, with key down for 5 to 10 minutes at a time. I found that if i kept the output to about 500 Watts in this mode, the amplifier showed no signs of overheating.

The claimed driving power is typically 85 Watts. Both my rigs (with outputs of about 100 Watts) drove the AL-80A to full power on all bands.

You can configure the amp for 120 or 240 volts AC by using jumpers on a terminal strip. An optional multi-voltage transformer is available, allowing for oddball voltages, such as 110, 115, 230, or 235. The filament supply has inrush current limiting to insure maximum tube life. A very efficient, quiet cooling system keeps the tube cool even during continuous operation.

The amp is shipped with the tube in a separate container, as it should be. In opening things up to insert the tube and to check for the proper voltage setting, I was impressed again with the good construction, steel chassis, clean layout, and the obvious high quality of the parts. Everything is well-shielded and bypassed to help with RFI and TVI problems. The power transformer, with a core of hypersil steel laminations, weighs about 22 pounds. The complete unit weighs about 50 pounds, with shipping weight a few more pounds. Its footprint is 8¾ inches high, 14¾ inches wide, and 15 inches deep.

Frequency coverage is 160 through 10,

including the WARC bands and most MARS frequencies. To enable the 10 and 12 meter bands, you have to make a very simple modification. All the parts are there; you just have to enable them. To obtain the information, write a note to the factory with a copy of your license, or talk to someone else who owns one.

The tuned input circuit (a necessity with most solid state exciters) is an adjustable Pi-network, and the output circuit is a Pi-L network, with harmonic suppression.

The claimed efficiency on CW/SSB is better than 66%. Spot checks on CW gave me between 67% and 70%.

Front Panel

The AL-80A has two illuminated meters, the left-hand meter being a multimeter which shows high voltage, plate current, RF output and ALC voltage, depending upon the switch position. The right-hand meter is only for grid current, and allows you to monitor this important parameter continuously.

Two rocker switches control POWER/OFF and OPERATE/STANDBY. In the standby position, the amp is out of line, and the exciter is operating straight through. Incidentally, the 3-500Z tube is an "instant heating" type, so there is no long wait for the tube to come up to operating temperature. (I hate to do that to a tube, though!)

The band switch has 160, 80, 40, 20, and 15 meter positions. The unmarked position to the right of 15 is the 10 meter position. It will work if you have enabled the 10 meter band, as discussed previously. Go to the nearest listed band on the band switch to reach the WARC bands.

Both the LOAD and PLATE controls have reduction gears, and provide very smooth tuning. There is a small red pilot light to indicate when the unit is in transmit. The controls are nicely laid out and easy to operate, even with my fat fingers and big hands.

Rear Panel

On the rear panel, towards the top, are two SO-239 connectors for the RF in and RF out. The remaining connectors are phono jacks. The next one down is for the relay, and goes to a normally open contact in your exciter. Unlike some of the older amplifiers with 100 volts DC, this amp only uses 12 volts at 100 mA to switch to transmit. All solid state rigs that I know of will handle that voltage nicely.

Next is the ALC jack, to supply ALC voltage back to the exciter. Below that is the ALC pot for controlling the ALC voltage. Below that, and at the bottom, is yet another jack that supplies 12 volts DC at 100 mA for any use you may have. There is a good heavy lug with a wing nut for the earth ground, and of course two fuses and the AC line cord.

Hookup and Operation

To configure the jumper block for either voltage setting, you need to take the case off. While the case is off, place the tube in its socket. There is an interlock switch for protection from high voltage if the cover is off and the amp gets plugged in and turned on. Voltages in there are high enough to be FATAL—don't bypass the interlock!

"I was able to use the WARC bands with just about full power by using the closest 'old' band position."

Be sure to have a good earth ground. Also, install a good heavy wire or braid connection between the exciter, the antenna tuner (if you use one), and the amplifier. I hooked up everything with ½-inch copper braid, and kept the ALC lead and the relay lead as short as possible. I used shielded wire, as the instruction book suggested, for the two leads.

The instruction book gives you a very brief outline of tune-up procedures. Tune up for the 80A is typical—you start with low drive and keep adjusting the plate and load controls for resonance at the operating frequency as you increase the drive. Keep the grid meter below 200 mA during operation. I made some notes as I went along, and marked the plate dial to make it easier to relocate the spot again. I tuned the unit up into a dummy antenna first before putting it on the air. With the availability of inexpensive dummy antennas, there is absolutely no need to do any of your preliminary testing on the air.

In order to get full output I needed to adjust the ALC pot on the rear of the amplifier. I used my station monitor, which happens to be one of the Heath SB series, to look at the RF envelope and to check for clipping as I set the ALC control. The instruction manual does not give you much information on this procedure, but most of the recent amateur handbooks have a detailed section on amplifier tune-up. After I finished the preliminary tests on the dummy load, I tried a couple of critical on the air checks, with a few of my hypercritical friends. All the reports were gratifying! I suspect most of the 100 Watt exciters probably will not give you much problem with clipping when used to drive the AL-80A, assuming everything is correctly tuned.

The band switch only covers the six "old" bands. I was able to use the WARC bands with just about full power by using the closest "old" band position. For example, the 12 meter band will work in the 10 meter position, and the 17 meter band will work in the 15 meter position.

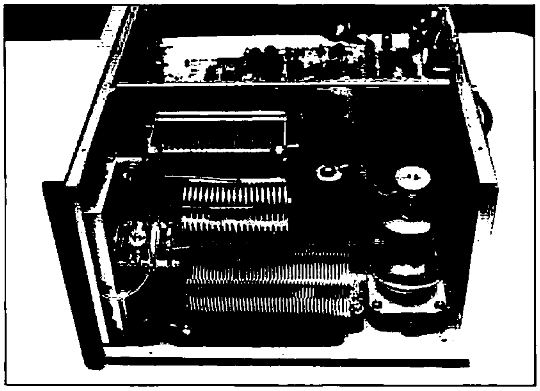


Photo C. The RF compartment, showing the Pi-L Network, the 3-500Z with fan just behind it, and the tuned input circuit which is just behind the front panel. The layout is clean.

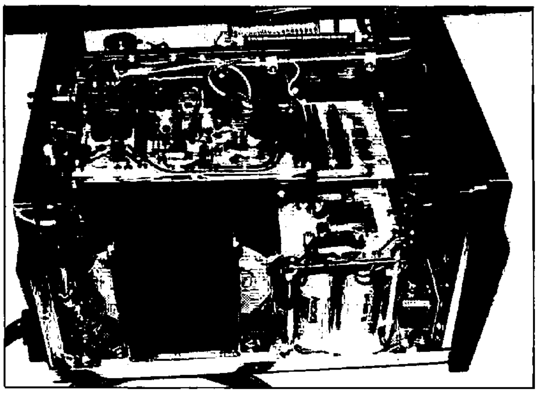


Photo D. The power supply compartment. Note the hypersil transformer, filter caps, and diodes. The horizontal circuit board above the transformer is the optional Pin 5 QSK board.

Final Comments

I wish the instruction manual were more detailed. The basics are all there, with parts list and schematics, but there could be more detail in, for example, the tuning procedures and ALC adjustment. Perhaps I am just spoiled with the Heath type manual! And speaking of Heath, their SB-1000 HF linear amplifier, available in kit form, looks suspiciously like the AL-80A! Who knows?

One other minor problem was the PO position on the multimeter. It it is supposed to show peak power out in Watts. Like many built-in power meters, it only shows a rough approximation of power which does not correlate well with an external meter known to be accurate. As long as the reading is not taken as gospel, you can use it as a relative indicator.

Having used the amp for several months now, I can report that it performs very well, with very nice reports. There has been no hint of instability even when the SWR was a bit higher than it should have been. It is quiet, reliable, and easy to tune. I obtained a Pin 5 QSK board for the unit, which I will try it out for a few months before reporting on it. All in all, the AL-80A was just what I was looking for, and I am certainly pleased with it.

73 Review

by Ed Clegg W3LOY

Uno, Dos, Cuatro

Introduction to the Numbers Stations

Tiare Publishing
Lake Geneva, WI 53147, (414) 248-4845
Price Class: $15

Has there ever been a ham who didn't experience a surge of excitement upon hearing a mysterious signal that sounded like a clandestine message? Don't we all have a little "Mission Impossible" or "007" in our blood?

With the advent of ham transceivers that include continuous receiving coverage from VLF to 30 MHz, some of us have become shortwave listeners as a hobby within our hobby. More hams are into SWLing than will admit it.

Shrouded in Mystery

According to the Publisher's note, "Uno, Dos, Quatro" was written by an ex-member of the intelligence community. Though the book offers only obscure info on him, the Preface states that "Havana Moon" has appeared in print elsewhere for several years. The note that he was quoted frequently in the Newark (NJ) news Radio Club testifies to his tenure since that periodical ceased to exist quite a few years ago.

Real Page-Turner

My curiosity was instantly piqued; midway through the first chapter I started tuning my TS-930 to frequencies where it had never been to before looking and listening for signals of the nature described by Señor Moon.

What is the nature of Moon's mysterious signals? Simply, groups of four or five digit numbers transmitted in a well-organized manner, and in various languages. He reports that many are delivered in English spoken with various alien accents, while some are in Spanish spoken with English or German accents. The author does not hint to the location of these signal sources in most cases, but there are notable exceptions, *including within the US.* Such US QTHs include Vent Hill, Virginia, a publicly known monitoring post for the government, and Tequesta, Florida, a unique government outpost which includes a LORAN station and missile tracking system. Moon also suggests that some numbers stations have questionable allegiance to the US, alluding to such transmissions from Cuba. Don't count on those transmissions coming from Guantanamo Bay!

The subject matter was so fascinating that I could endure the disorganized presentation. Some chapters consist principally of lists of frequencies where one has a good chance of hearing these mysterious transmissions. In later chapters, however, Moon tells us that previously listed frequencies may not be currently active. There is little or no indication in the text that some of the "high probability of intercept frequencies" are daytime or nighttime predictions, *except for the one I experienced and was able to confirm on two separate instances!* In this case, the author accurately forecasted not only the day of the week and the time of the day, but also the apparent source in Florida. I discovered that the time, frequency, and apparent source were all accurate! That experience alone was enough to justify the purchase and get me hooked.

The book is a paperback in large sheet format with 90 pages including about a dozen pages that were either afterthoughts or later edition supplements. These include a listing of other related publications by the publisher and excerpts from *Monitoring Times* as well as *Popular Communications.*

Fire Up The SW Receiver

Give a listen sometime to 11,565 kHz at 2000Z on Saturdays, and you may well be in for a pleasant surprise. Now I'm in the market for a multi-frequency, multi-channel, long-long-long playing tape recorder so that I don't miss out on any of these mysterious signals.

This book has certainly whetted my appetite. I look forward to seeing a guide to possible meanings of these codes! Anyone interested in forming a numbers stations monitoring net?

Number 11 on your Feedback card

73 Review *by Larry R. Antonuk WB9RRT*

Ramsey COM-3

The most features for the money in communications service monitors.

Ramsey Electronics, Inc.
2575 Baird Road
Penfield, NY 14526
Tel: (716) 586-3950
Price Class: $2500

"I just bought a $2500 service monitor!" Drop that statement into polite ham conversation, and you're guaranteed one of two resposes:

A. "Wow!"

B. "What's a service monitor??"

From Many Boxes to One

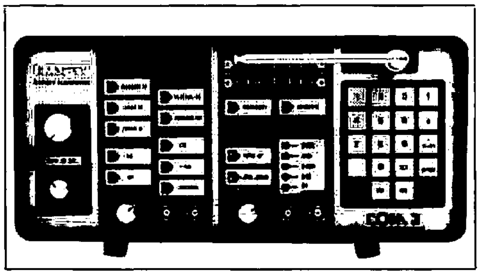
First, the answer to "B." A communications service monitor is a tool used by anyone in the two-way radio business, or anywhere that precise measurement of radio parameters is needed. In the days before synthesizers, phase-locked loops, and memory scan, back when they even used tubes, technicians needed to carry several pieces of equipment.

First, he needed a wattmeter for indicating forward and reflected power. Next, he needed a frequency meter to give him an idea of whether or not this power was on the correct frequency. Once he was assured of that, he could pull out his modulation meter to check his transmitter's deviation. If the deviation is within the specifications, he loads all of the equipment into the van and hauls out the signal generator to measure the receiver's sensitivity. He could then modulate the signal generator with an audio tone generator to check the audio circuits. A CTCSS generator would let him check the private line (PL) operation. All in all, a well-equipped technician could easily have half a dozen boxes with him at all times. Imagine having to hike up a mountain while trying to decide which equipment to haul along!

A few years back, technology advanced to the point where it became feasible to roll all of these pieces of equipment into one box. These units were called system analyzers, communications monitors, etc., but the term "service monitor," or simply "monitor," stuck. Today's service monitors combine all of the above features, with the more advanced units performing spectrum analysis, tone decoding, and many specialized functions. The only problem with service monitors is the price.

Obviously, a unit that can take the place of six pieces of test equipment has to cost seven times as much as the most expensive piece! Indeed, the price of the average service monitor is around eight thousand dollars, with some deluxe models clearing the twenty thousand mark.

Now microprocessor technology has developed to the point where Ramsey Electronics can offer a full-featured communications service monitor for $2495. The Ramsey COM-3 measures frequency, modulation, and receiver sensitivity—all the normal service monitor functions. In addition, the unit offers several features not found on units costing three times as much: a ten channel memory, repeater offset buttons, audio frequency counter, RF frequency counter, CTCSS tone generator, and built-in battery pack.


The Ramsey COM-3 Service Monitor packs a lot of tools into a single unit.

Now for the Wow

The COM-3 package measured 12" x 5.5" x 14" and weighed a mere 13 pounds. The controls on the front panel are the on-off/volume, squelch, and RF level controls. You access all other operating functions, such as generator attenuation, in addition to basic numeric input, with the membrane keypad, which covers the entire face of the unit.

As far as basic service monitor functions, the COM-3 has the same capabilities most monitors have. You can generate or monitor frequencies from 100 kHz to 999.9999 MHz. The generator has a range of 0.1 µV to 10,000 µV, and can be modulated by an internal test tone or CTCSS tone.

The unit measures modulation in two ranges, 1.5 and 7.0 kHz, on a 20-segment LED bargraph. In addition to these functions, however, the COM-3 performs quite a few tricks of its own.

Once you get used to the keypad frequency entry system, you'll want to store often-used frequencies in one of the ten memory positions. Rather than simply storing frequencies, these positions store complete operating modes. For instance, memory one could generate 147.375, modulated with 1 kHz tone and 123.0 Hz PL tone. Hit memory two, and you're monitoring 448.600 MHz, AM mode, counting PL tone. All at the push of two buttons. If you don't know the freqency, simply use the built-in frequency counter. Once you count the frequency, put that freq in the monitor and enter the Audio Freq Count mode to decode any CTCSS tones.

Service techs will especially appreciate the programmable plus or minus offset buttons, and an up/down 5 kHz at-a-time function. The first feature makes it easy to switch back and forth between a transmit frequency and the associated receiver frequency of a repeater pair, and the second feature acts like a VFO, letting the operator "tune around" to check the bandpass of a receiver, etc.

The COM-3 cannot measure RF power, but it can protect itself from it. Once the unit senses input power of more than 500 mW, it switches the input to a BNC connector on the back panel. (You previously attached a dummy load to this port, of course, anticipating that you were going to goof and key a radio into your brand new monitor.)

Drawbacks

The COM-3 has very little in the way of RF shielding. Once the cover is removed from the unit, the large main board sits relatively unprotected on the bottom of the case. It doesn't have the heavy shielding, bypassing, and fingerstock seen on some monitors. While this might present a problem at a commercial broadcast station or a crowded repeater site, most hams and radio technicians will find the RF immunity of the monitor more than adequate.

Speaking of broadcast stations, the FM monitor mode is designed only for 5 kHz systems—75 kHz commercial systems can't be measured. One final point concerns the lack of an "image" switch to identify "birdies." Like all monitors, the COM-3 produces birdies (as do all monitors), but we have no way to distinguish birdies and image frequencies from the real thing.

Conclusions

All in all, the Ramsey COM-3 is an exceptional instrument. Whether purchased for a two-way shop, ham club, or for a ham making the transition to a service business, the COM-3 represents a lot of equipment for the dollar. With the addition of the optional case ($90) and the carrying handle/front cover ($30), the unit becomes a go-anywhere service tool. There's really only one word for it: "Wow!"

Control Your Rig from a PC

Simple interface for an IBM-PC or clone and many new synthesized HF rigs.

by William Waters N7IPY

Today's new, full-functioned solid-state radios have many powerful features that, with a little time and creativity, you can control from your computer keyboard. Many radios have a serial data computer interface, composed of hardware and software, that allows you to change functions, such as the VFOs, RIT, and memory channels from your keyboard.

Why would you want to do this? To save time and effort while setting and changing memory channel information. The Kenwood TS-440S, for example, has 100 memory channels, each holding the frequency and mode of operation. Adding or changing channel data is time-consuming; this program and interface makes it much less so.

The Hardware Interface

I discuss Kenwood radios here, but ICOM and Yaesu radios have similar interfacing capabilities.

On the back of the Kenwood TS-440S, R-5000, and TS-940S (added to the TS-711S/811S with the Kenwood interface kit), there is a connector labeled ACC1. This is the serial I/O port of the radio. The signal level is 5 volt TTL (Transistor-Transistor Logic). This signal level is not acceptable for most computers, which require RS-232 voltage levels; i.e., +12, −12. Directly connecting the radio to the computer could damage the radio's control electronics. The first part of the hardware interface is the TTL to RS-232 level translator, with the proper interface cables and power supply voltages. See Figure 1.

The basic translator or interface consists of three ICs. One IC is a 1488 quad line driver that converts the TTL signal levels to RS-232 signal levels. The second IC, a 1489, converts the logic level in the opposite direction (from RS-232 to TTL). The third IC, a 74LS04 hex-inverter, inverts the radio's RXD and TXD signals. The interface electronics require three separate voltages: +5, +12, and −12, all at a very low current.

Kenwood radios have five interface signals on the 6-pin DIN connector, ACC1, for serial data communications. Figure 2 shows the signals and their pin numbers. Only TXD (transmit data), RXD (receive data), and GND (ground) signals are needed to communicate to the computer, but it is a good idea to include the CTS and RTS lines in the interface design.

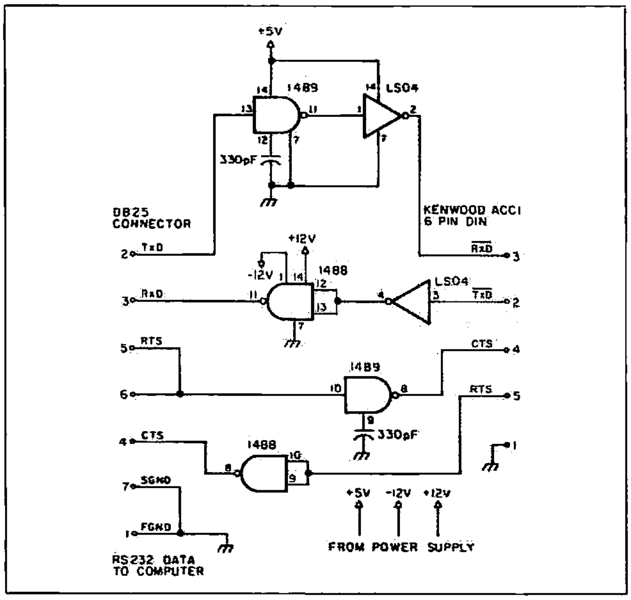


Figure 1. The computer RS-232 to Kenwood 5-volt TTL interface schematic.

For the computer, I used an IBM clone with a multi-function board that supports two RS-232 serial data ports. Both ports are brought out to the back of the computer via two standard DB-25 connectors called COM1 and COM2. By connecting (through the interface) the radio's TXD to the computer's RXD, and the computer's TXD to the radio's RXD, you achieve full communications between the radio and the computer.

A Few Chips for the Rig

For the Kenwood radios that support the serial interface, you need an accessory to enable this function. In the TS-440S and R-5000, you must install two ICs into the control unit: an 8251A (a UART, or Universal Asynchronous Receiver Transmitter), to convert serial data to parallel data and vice versa; and a CMOS CD4040 12-stage binary counter to support the UART. Refer to the Kenwood instruction manual for details on the installation of these two ICs.

This Kenwood accessory is called the "IC-10 Kit" for the TS-440S and R-5000. It contains the two ICs and the instruction manual with all the information on the commands. If you plan to buy a ready-made program, you do not need the IC-10 Kit. You won't need the kit's software manual, and you can buy the two ICs from many electronics parts mail order companies, for a fraction of the cost of the Kenwood kit. On the TS-940S/711S/811S, the interface kit consists of an additional circuit board, a new EPROM (Erasable Programmable Read-Only Memory), and instruction manual. You will find

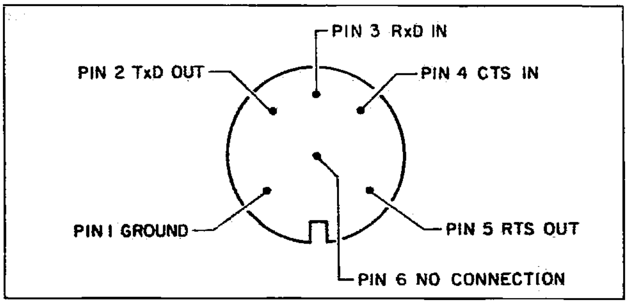


Figure 2. ACC1 DIN connector on the Kenwood rig.

this kit at a Kenwood dealership. The interface kit for the TS-711S/811S is called the "IF-10A" and the interface kit for the TS-940S is called the "IF-10B." Both come with instruction manuals.

The Software Interface

After the hardware is ready, the software must be developed. The Kenwood radios have an interface language consisting of 17 commands for the R-5000, 19 commands for the TS-440S, 20 for the TS-711S/811S, and 22 commands for the TS-940S. These commands allow the control of functions like:

—Programming and recall of VFO A and VFO B frequencies
—Memory Input and Memory Recall
—Memory Channel Selection
—Mode Selection
—Control of RIT/XIT and frequencies
—Complete status updates of the radio operations

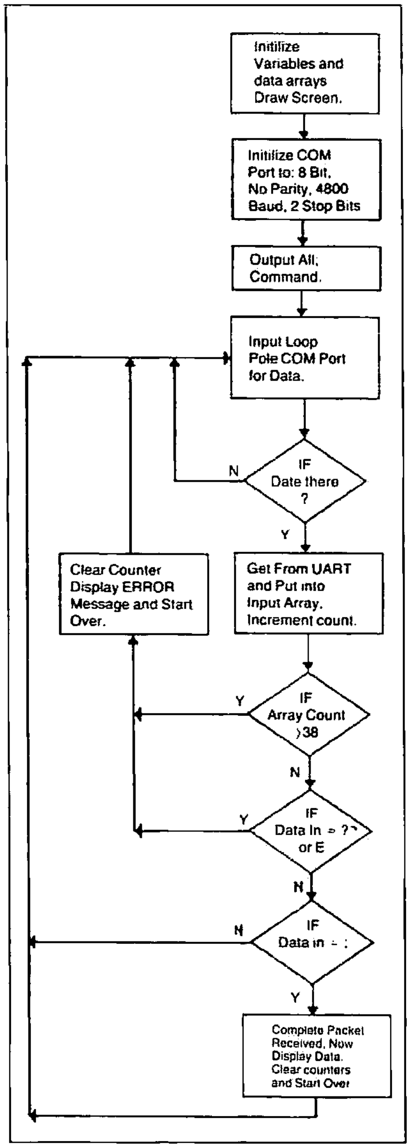


Figure 3. Flow chart for the radio status monitoring program.

Along with the basic commands, there is a well-defined protocol for controlling communications between the two pieces of equipment. After every command from the computer or response from the radio, a semicolon ";" is sent at the end of the data or command packet to tell the other end that the transmission is complete. The radio can tell the computer that it could not understand a command. If the computer sends data too fast, the radio will reply with an "E;" which signals an overrun or framing error in the transmission. If the command syntax is incorrect, or the radio cannot execute a command, it replies with a "?;" which informs the computer of a problem.

I prefer the programming language "C," but you can use BASIC, FORTRAN, PASCAL, or another language. The most important considerations are the language's speed and its ability to send and receive data from the communications port. Below is an example of how I communicate to the UART using "C":

ch_in = inportb(io_adr);
Where:
ch_in = the data from the UART
io_adr = the hardware port address.
inportb() = the input function.

outportb(io_adr,ch_out);
Where:
ch_out = the data to be sent.
io_adr = the hardware port address.
outportb() = the output function.

At first, I used the language's high level interface to handle the UART, but that was not fast enough, so I had to go to a direct I/O method. These commands would be very similar in most languages. The main thing is to get data to and from the UART as fast as possible.

Three of the common commands the radios support are:

ID; Identification of radio type. Reply as follows:
ID001; - for the TS-711S.
ID002; - for the TS-811S.
ID003; - for the TS-940S.
ID004; - for the TS-440S.
ID005; - for the R5000.

AIx; Turn ON or OFF the Automatic Information transfer from the radio. Here, x = 1 for ON and x = 0 for OFF. The reply data format is the same as the IF; command.

IF; This command asks for the radio's current condition. The reply data packet is 38 bytes long, and structured as follows:

Bytes	Description
1 and 2	IF. Command name.
3 to 13	Selected VFO frequency in Hz. Note that the first three bytes are not used.
14 to 18	Step frequency in Hz for TS-940S, TS-711/811.
19 to 23	RIT frequency. (E.g. +0100 or −1250.)
24	RIT On/Off. 1=On, and 0=Off.
25	XIT On/Off. 1=On, and 0=Off.
26	Memory Bank. TS-940S only.
27 to 28	Memory channel.
29	TX/RX. 0=RX, and 1=TX.
30	Mode. 1=LSB, 2=USB, 3=CW, 4=FM, 5=AM, and 6=FSK. AM, FSK. TS-440S/R5000/TS-940S only.
31	Function. 0=VFO A, 1=VFO B, 2=MEMORY.
32	Scan On or Off.
33	Split On or Off.
34	Tone On or Off. TS-811A, B, E/711A, E only.
35 to 36	Tone Frequency, TS-811A, B/711E only.
37	Offset. 0=Simplex, 1=+, 2=−. TS-711/811 only.
38	Terminator character. This is ";".

```
5 REM IOTEST.BAS - Interface Test Program
10 PRINT "Interface Test, Enter Q to Quit."
15 OPEN "COM2:4800,N,8,2" AS #1:WIDTH #1,255
20 PRINT #1,"A";:PRINT #1, "I";
25 PRINT #1,"1";:PRINT #1, ";";
30 A$=INKEY$:IF A$="" THEN 70
35 IF A$="Q" THEN 90
40 PRINT A$;
45 PRINT #1,A$
70 IF EOF(1) THEN 30
75 A$=INPUT$(LOC(1),#1)
80 PRINT A$:
85 GOTO 30
90 END
```

Figure 4. BASIC program for testing the computer/rig interface.

The IF; command need not be sent for constant updating of the data array, because the radio will automatically send tbe data packet every time one of its settings or conditions change, provided the AI1; (AI on) command has been sent.

Testing The Hardware

After the hardware is assembled, connect the IBM PC or clone to the radio via the interface unit. A test program, IOTEST.BAS, is given in Listing 1. It is written in GWBASIC, but other versions of BASIC will work with little or no changes to the code.

The program initializes the computer's COM2 port, sends a request to the radio for information, and then waits for data from the keyboard or serial port. If data from the radio is sent, the computer will display it on the screen. If you press a key, it will display that character and then send it to the radio. If your serial port is COM1, change line 15 accordingly. This simple test program does not do any error checking and is intended only to test the hardware function.

Enter the program and run it. If you rotate the VFO knob, you should see a block of 38 bytes displayed on the screen. If so, your interface electronics are working properly. If not, go back and check your work. You will notice that the radio sends the data only when a condition has changed in its operations or settings, and then only after one to two seconds after the change occurred. This is a feature of the radio's control microprocessor. It doesn't send serial data when it is busy doing other operations, such as dealing with the VFO tuning knob as it is rotated. This ensures that all changes are completed before the radio sends out new data.

A Simple Program Example

Because a full-functioned control program

is too complex for an article, I give here only a simple and understandable example. The flow chart shown in Figure 3 will help those programming in different high level languages.

Initialization

This is where the program starts. Define any variables, if the language needs them. I recommend using a 38 byte array for storing the radio information as it is received. Initialize the serial data port for 4800 baud, eight data bits, two stop bits, and no parity. You can also paint the display screen at this point.

Input Loop

The input loop should be as fast as possible with minimum steps, thereby allowing polling of the input port. If done correctly, you will be able to run the program on the slower 4.77 MHz IBM PC. When a character is ready, read it into the input array and increment the array pointer, making the UART ready for the next character.

After reading a character from the UART, three conditions must be tested: 1) whether or not the input array is full, indicating a communications problem; 2) whether or not the last received character was a "?" or an "E," indicating a communications problem; and 3) whether or not the character was a ";" indicating the end of the data packet from the radio. If the data was received and terminated properly, you will want to display it on the screen, overwriting the old screen data. If any of the error conditions exist, you will want to display a small error message, reset the array pointer to 0, and get ready for the next packet of information.

Where To Get Parts

All of the parts in the basic interface unit are available at Radio Shack. The Radio Shack part numbers are listed below. The interface kits IF-10, IF-10A, and IF-10B are available from any Kenwood dealer. You can also get a full-featured program for the Kenwood from Rad-Com, PO Box 1166, Pleasanton CA 94566; 408-443-4633.

Conclusion

From this basic understanding, you could design a very comprehensive program to control the functions of the radio in a real-time operating mode. Along with the novel process of controlling the radio from the computer, you accomplish a much more important function—full memory channel management through your computer, which saves you time and makes the radio easier to use. ■

Parts List for Simple Interface Unit

1	MC1488 Line Driver	RS# 276-2520
1	MC1489 Line Receiver	RS# 276-2521
1	7404 Hex Inverter	RS# 276-1802
3	14 Pin Sockets	RS# 276-1999
1	6 pin DIN Plug	RS# 274-020
1	Small PC Board	RS# 276-158

Misc.: Small enclosure, cable, low current +5, +12, and −12 volt power supply.

73 Review *by Jim Kocsis WA9PYH*

Ramsey Electronics
2575 Baird Rd.
Penfield NY 14256
(716) 586-3950
Price Class: $25

Ramsey SR-1 Receiver

A lot of listening fun at an affordable price.

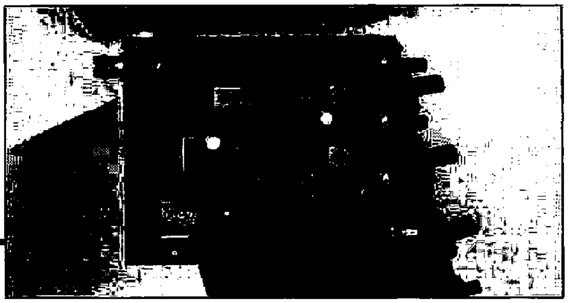


Photo A. Top view of the the assembled Ramsey SR-1 receiver. (Photo courtesy of Bob W8MDV.)

Ramsey Electronics offers inexpensive kits ranging from frequency counters to LED blinkers and small receivers. This simple, inexpensive AM-only shortwave receiver is a great starter project for budding hams.

Assembly

The parts come in a plastic bag with a single-sided phenolic PC board that has a solder mask but no component markings. The absence of a component layout on the board isn't a problem because the page that accompanies the kit shows the location of all the parts. I strongly recommend placing all large components first (transformers, pots, antenna connector, etc.). Next, mount all the resistors and capacitors. Add the transistors, diodes, and ICs last. Don't "jump the gun" like me and forget the jumpers. (I was anxious to see how this little receiver worked.)

This unit is easy to assemble. For an experienced kit builder, the assembly time is 1 to 2 hours. All but one part fit perfectly; there was not enough room for the large 220 µF capacitor at pin 8 of the NE602 IC. I managed to make it fit on top, but you could also mount it beneath the board. The disc capacitors are not all marked as described, but by the process of elimination you can figure out that the 100 pF capacitors are marked 100k, not 101, and the 0.01 µF capacitors are marked 0.01, not 103. I would guess that Ramsey switched sources for their parts so the instructions are not quite correct. The mismarked components are really a very small point, since overall the assembly was very easy and straightforward.

Two of the transformers need to be modified by breaking out a small internal capacitor. Otherwise, all parts can be used as supplied. There were no extra holes in the board and no extra components. (The appearance of mysterious extra holes or parts can be confusing to the beginner. Ramsey did really well in this area.)

Tuneup and Operation

I applied power (a 9 volt battery), added a 10 foot piece of wire for an antenna and an earphone, and immediately began tuning in LOTS of shortwave stations. Actual tuneup consists of peaking a single 262 kHz IF transformer and presetting the local oscillator and antenna coils for the desired 2.5 MHz segment of the receiver's 4–10.5 MHz coverage. In a few minutes of listening I heard the BBC, CBC, and many Spanish-, German-, and French-speaking stations.

The three controls—RF gain, AF gain, and tune—are potentiometers. Use the RF gain if there's so much signal coming in that the simple AGC circuit can't handle it. The audio output is more than enough for an earplug, but there isn't sufficient audio for even a small speaker.

> *". . . assembly time (for the SR-1) is 1 to 2 hours."*

Technical Information

This receiver uses the Signetics NE602 for the mixer/local oscillator; a two-transistor IF amplifier with a doubly-tuned transformer comes next. The IF amps are followed by 2 op amps used as an audio preamp, and an AGC amplifier. A single transistor forms the audio output stage. Current draw at 9 volts is 45 mA, so the battery should provide many hours of listening.

Plusses: The receiver is really hot, mostly due to the NE602. The chip is just coasting in this frequency range—it can actually operate up to 500 MHz RF input with its own local oscillator running at 200 MHz. The assembly, tune-up, and operation are all very straightforward. No special tools or equipment are required.

Minuses: The overriding problem with the receiver is: "What is the frequency?" There is no frequency indication—all tuning is done with a pot-tuned varicap (voltage variable capacitor) and the oscillator coil. There are also a few heterodynes as the receiver is tuned throughout the selected range. This is an indication of inadequate front-end selectivity. Another problem area involves the RF and oscillator coils. Tuning these coils requires a very small screwdriver-type alignment tool. I've seen these types crack after several adjustments. Adjust them sparingly or consider installing another type of coil.

Modifications

As an option, you can supply an external oscillator signal to the NE602. It should be at least 200 mV peak-to-peak. Ramsey doesn't provide this option or describe it. Consult the Signetics Linear Data Manual, Volume 1 for more information on this IC.

For the experienced builder, I would recommend adding a BFO or product detector for CW/SSB reception, an LM386 audio stage for speaker operation, and more tuned RF stages to improve the image rejection. Some type of frequency synthesizer in place of the local oscillator would also be useful. (Signetics and other companies make several synthesizer chips that might be used here.)

Another option for frequency read-out is the addition of a simple buffer and frequency counter. This could involve a lot of work and extra parts, and would detract from the simplicity of this receiver.

An Overall Good Deal

Am I glad I bought this receiver? You bet! I plan on putting it in my car and listening to SW instead of the local AM-FM broadcast "chatter," or when 2 meter FM is inactive. Ramsey did a fine job on this receiver. The price is reasonable, and all parts are high quality. (Ramsey uses the same NE602 chip in their 80/40 meter hamband receiver, in a 2 meter receiver and in an aircraft receiver—all reasonably priced.) You can also buy an optional plastic receiver case for $12.95.

Do you remember your first kit or project? I've been building kits and home-brewing since 1962. I can honestly say that this one was nearly as much fun as the first!

CTCSS

Continued from page 16

ter, will generally be satisfactory. In one or two cases, with older synthesized transceivers using the Motorola MC4044 Phase/Frequency Detector in a phase-locked loop circuit, we obtained the best results when we coupled the output of the PL board directly to the varactor diode. If you do this, make sure that the 0.47 (or 0.50) µF capacitor is not a tantalytic.

Just as some manufacturers provide a connecting point for a PL signal, some also offer a front panel switch-controlled power source. Such was the case with the Kenwood and the Azden models. If so, by all means take advantage of it. Even though this CTCSS board uses very little current, it's preferable to take it from the transmitter source.

The circuit diagram of Figure 1 suggests a Vcc of 13.8 volts, but any voltage from 6 to 13.8 works, as long as that is the voltage applied when tuning the oscillator. The current requirement varies from about a low of 7.4 mA at 8 volts to about 9.5 mA at 12 volts. It should not pose a problem for even a small battery.

If you use a mechanical relay to switch power to the transmitter finals, you can usually find a switched positive 8–12 volt source at one of the relay terminals. To get the tone when you want it, put a wire from that point to a mechanical switch at some accessible place on the cabinet, and from there to the CTCSS supply terminal. The switch lets you disable the tone when you don't want it.

When you use a transistor switch, rather than a relay, to key on the transmitter finals, you have a couple of choices. If you're sure about what you're doing, pick up the 8–12 volts your rig uses at the same point that the transmitter final uses it. Bring the ground wire of the CTCSS board to the collector (or the emitter, as the case may be) of the transistor that actually keys on the power transistors. If you're not comfortable doing that, go to the same source point, but take the ground wire from the CTCSS board to the open side of the PTT (Push-to-Talk) switch in the microphone circuit. You will probably still want to use a mechanical switch to disable the CTCSS board when you're not operating PL.

If you're not using a voltage source provided by the manufacturer, it's a good idea to protect the CTCSS circuit—and your audio signal—against unwanted RF. Use the 0.001 µF bypass capacitor as shown on the schematic.

Various Installations I Have Done

Photo B shows the underside of a Conarc 452 2-meter transceiver. The CTCSS board seen at "A" was the prototype installation. You can get a feeling for the size from the small dual-operation amplifier IC just left of center, and the ¼-watt resistors.

At the left of the chassis, just inside of the SO-239 connector, is a large relay for power and antenna switching. An accessible terminal that goes to 13.8 volts when the transmitter is keyed on, provides the voltage source. A toggle switch, barely visible near "P," interrupts the current supply when you don't want PL operation. Because of the length of wire needed to get from the relay, to the switch, to the tone board, an RF bypass capacitor (see Figure 1) was used. The CTCSS tone is injected at the varactor diode used for modulation. There are two small potentiometers on the right end of the board: one for frequency control, and the other for signal amplitude. Unfortunately, the devices available from Radio Shack are not as tiny as the junk box specials seen here.

In the Azden PCS 4000, the manufacturer provides both a connection point for the tone signal and a switched voltage source for the board. The signal-in point is shown on the transceiver's schematic as the inverting input on an operational amplifier; the microphone input is the noninverting input of the same device. I mounted the board at the front end of the component side of the Azden's main board, in the left corner, when facing the front panel.

This installation furnished an interesting problem. The circuit diagram that came with the Azden is wrong. It shows a terminal, J406, and identifies this pin as the tone input; supposedly the input to the op amp noted above. Actually, it is the terminal which provides 8 volts when the tone switch on the rig's front panel is engaged and the PTT squeezed. To get to the op amp (at "B"), you must connect the wire from the CTCSS board to a lead of resistor R464. Otherwise there was no difficulty. Even the best of us make mistakes!

Installing the board in the Kenwood TR-7850 was straightforward. The manufacturer provided junction points (see the manual) for the tone signal, Vcc, and signal ground. We built the board to be as narrow as possible, and longer, so that it could be positioned on edge behind the front panel.

Because of the high risk of shorting against other devices, a piece of cardboard, cut to fit and taped to the bottom, exposes only the tuning potentiometers. Again, because the hook-up wires stretch quite a ways across the transceiver chassis, recourse was made to the bypass capacitor. It is mounted on the underside of the CTCSS board.

Conclusion

With these examples and your imagination, you should have very little trouble adapting the circuit to your rig. Although the design is for a single tone, you can readily modify it to offer two tones by adding another tuning potentiometer, a fixed resistor, and if necessary, a switch. If you have to use an external power switch, as we did for the Conarc 452, you could make it a double-pole-double-throw-center-off switch to do double duty for ON/OFF and frequency select.

Think Big

This easy, one- or two-evening project is full of possibilities. Since it's at audio frequency, layout is not at all critical. Admittedly, you will need a good low frequency counter to adjust the tone, but if a repeater is near, that shouldn't be a problem. Just contact the trustee. With any luck, you'll find one close at hand, and you'll have the pleasure of home-brewing as it used to be—at minimum cost! 73

Full-Wave VHF Vertical Antenna

Easy-to-build, good gain antenna.

by Don Norman AF8B

This full-wave vertical antenna grew out of a series of experiments with the vertical J antenna. The result is a full-wave antenna easily built by the average amateur. The final version of the antenna is matched by a form of gamma match, and features full RF decoupling from the feedline.

The antenna can be grounded and in fact may be a continuation of the supporting mast. The 52Ω coaxial feedline runs up inside (MUST be inside) the antenna. It emerges through a ⅜" diameter hole next to the feedpoint on the matching stub. The diameter of the radiator does not seem to be critical, as working models have been built with radiator diameters ranging from ⅝" to 1¼".

Antenna dimensions for 145 MHz (packet) are given in Figure 1. You can easily build the antenna from a 10-foot length of ½" electrical conduit. The insulators are fabricated by cutting a plastic pipe tee in half. This plastic pipe tee, used mostly with semi-flexible plastic pipe joined with molded fittings and hose clamps, is common in hardware stores. A single 1" tee cut along the line shown in Figure 2 will yield two insulators that will fit over the ½" EMT tubing.

Cut the matching rod from #10 copper wire, 3/32" brass brazing rod, or ⅛" copper tubing. Cut the radials from brazing rod or hard aluminum wire, and attach them to the radiator with self-tapping sheet metal screws.

The first step in building the antenna is drilling holes in the metal tubing for the coax and radial attachment. Mark one end of the tubing "Top." Drill a ⅜" hole through one side of the tubing 40½" from the top. Drill

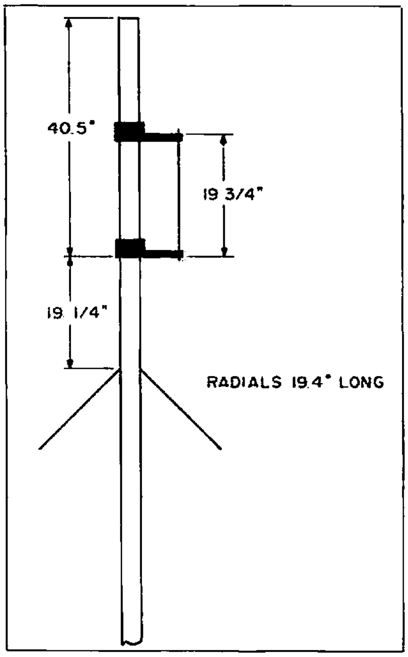


Figure 1. Full-wave vertical dimensions for 145 MHz.

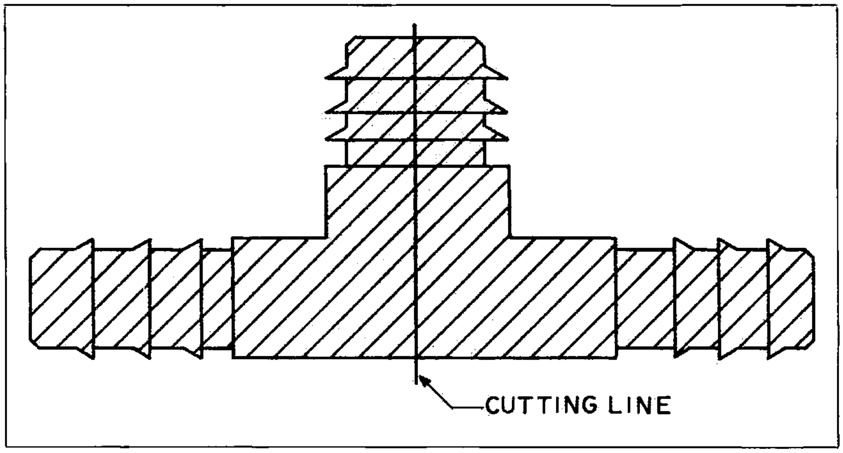


Figure 2. Make the insulators by cutting a plastic pipe tee in half.

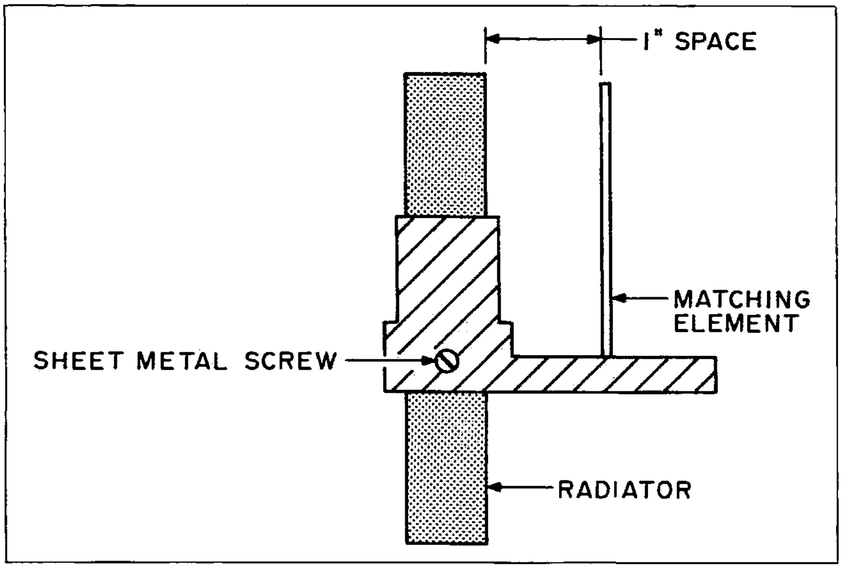


Figure 3. Matching element and bottom insulator attachment to vertical element.

three or four ⅛" holes for sheet metal screws 59¾" from the top. Use a round file to remove burrs and snags from the inside of the ⅜" hole. Fish the coax cable up through the tubing past the small holes and out through the ⅜" hole. Figure 3 shows the matching element and bottom insulator.

Cut the insulators. Measure and cut the gamma matching rod. Slip the insulators over the tubing and measure 1" from the main tubing, then drill small holes through the projecting part of the insulators large enough to accept the matching rod. The distance between the radiator and the matching rod is critical. Use your best concentration, and make the spacing as near to 1" as possible. Refer to Figures 3 and 4 for proper bottom insulator placement.

". . . the antenna is matched by a form of gamma match, and features full RF decoupling from the feedline."

Slip the bottom insulator over the radiator, place it as shown in Figure 4, and drill a small hole through the insulator and the radiator. Lock the insulator in place with a self-tapping sheet metal screw. Attach the shield of the coax under this screw. Cut a 3" piece of small bare wire. Wrap one end around the gamma rod an inch from the end and solder. Slip the second insulator over the radiator. Slip the matching rod through the holes in the insulators. Solder the center conductor of the coax to the end of the matching rod. Move the top insulator upward against the 3" wire soldered to the matching rod. Bend the wire around the insulator and wrap around the matching rod. Lock the insulator in place with a sheet metal screw.

Figure 4 shows the bottom insulator rotated 90 degrees from Figure 3. Notice that the coax end is protected by the semi-circular bottom of the insulator.

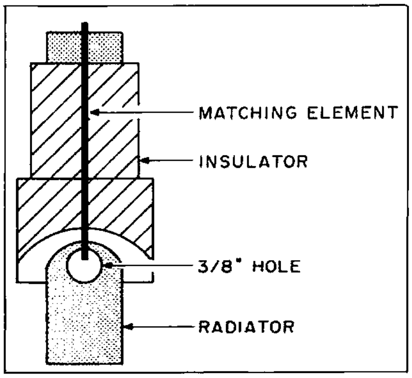


Figure 4. Bottom insulator placement. The coax end is protected by the semi-circular bottom of the insulator.

Install the radials. Cut the radials 1" longer than the correct dimension. Bend one end in a small circle and attach the radials to the radiator with sheet metal screws. CAUTION! Don't pinch the coax with the screws! The radials are clipped to the correct dimension after they are installed. The radials, an essential part of the antenna, decouple the RF from the support and feedline. Their dimensions are as critical as the rest of the antenna.

Performance

Checking the antenna with an absorption wavemeter indicates the presence of RF from the tips of the radials upward in the classic patterns depicted in the various antenna manuals.

On-the-air tests indicate it is equal to or better than a commercial ⅝-wave vertical.

Choose Your Resonant Frequency

Dimensions for frequencies other than 145 MHz may be calculated as follows: Radiator above the feedpoint, 5872/Frequency (MHz). Feedpoint to radial attachment point, 2790/Frequency (MHz). Matching rod length, 2865/Frequency (MHz). Radial length, 2810/Frequency (MHz). Matching rod spacing, 146/Frequency (MHz). The spacing of the matching from the radiator is the most critical measurement. A quarter-inch more or less makes a great difference in the performance of the antenna. Radial length and placement are somewhat critical and should be within a half inch of calculated dimensions.

That's all there is to it. Enjoy solid signals with this easy-build vertical! ■

Find Your Signal the First Time!

Getting the shift of it.

by David G. Hart AA6CQ/VE6

So where is your signal on the bird? You've got your new Mode B equipment and you continue having trouble locating your downlink frequency. The most likely problem is the Doppler shift. Once you have the translation frequency figured out, you still have to account for the dreaded Doppler shift. This shift not only makes it difficult to locate your own signal and start a QSO, but you may also inadvertently transmit right over someone else. This is especially critical when the bird is crowded.

In this article I will explain a little about the Doppler shift equation (unfortunately, yes), the Doppler shift effects, and illustrate some simple methods to find your signal the first time, and I will let you in on some simple rules. Included is a simple BASIC computer program to help you along.

The Doppler Shift

Everyone has experienced the Doppler shift, first described by Christian J. Doppler in 1830. When a speeding train is approaching you and blowing its whistle, the whistle's pitch becomes higher and higher until it passes you, then it becomes lower and lower in pitch as the train recedes from you. The same thing happens to your radio transmission to the satellite. Complicating this is that you are both transmitting TO the satellite and receiving FROM the satellite at the same time. You have to account for Doppler shift on both the uplink and downlink channels.

The Doppler shift equation is:

$$f^* = f_o \pm Vr/c(f_o)$$

where f_o is the transmitter frequency measured at the transmitter and f^* is the received frequency. The ± means that the received signal can be either higher or lower than the transmitted frequency, depending on whether the satellite is moving towards you or away from you. *Vr* is the relative velocity of the satellite, and *c* is the speed of light.

If the satellite is moving towards you, the signal received will be higher than the actual signal the satellite is transmitting. *Vr* is positive. Also, the frequency the satellite receives will be higher than your actual transmitted signal. The difference in frequency is due solely to the magnitude of the relative velocity, *Vr*.

Typical maximum relative velocities are around 4 km/s (14,400 km/h!). Fortunately, these occur generally at or near perigee, where you won't be operating much.

In general, the magnitude of the relative velocity is the key to knowing the proper uplink frequency. Here I will calculate the *Vr* from actual satellite transmissions. You can calculate *Vr* directly from orbital data or slant range (the distance from you to the satellite), but it is tedious by hand. Many programs are available to do the calculations. ORBIT-II is an MS-DOS program available from AMSAT which also calculates Doppler shift.

Calculating the Shift

All major satellites have beacons. Since these beacons are on a fixed known frequency, it is very easy to use the Doppler equation to calculate the relative velocity, and then go on to calculate other Doppler shifts.

For example, the beacon frequencies on OSCAR 13 are 145.985 and 145.812 MHz on Mode B; 436.677 and 436.651 MHz on Mode JL; and 2400.664 MHz on Mode S. Simply listen for any of the beacons and note the frequency that you hear them on. They will be different from the actual transmitted frequency. If you hear the Mode B engineering beacon at 145.813500, the Doppler shift is 1500 Hz. To calculate the relative velocity, insert these numbers into the Doppler shift equation and solve for *Vr:*

$$145{,}813{,}500 = 145{,}812{,}000 + Vr\,(145{,}812{,}000/300{,}000)$$

Vr is equal to 3.09 km/s

Note that the apparent shift of 1500 Hz does not mean that your uplink frequency is

```
10 ModeBB# = 145.812
20 ModeBT# = 581.398
30 ModeLB# = 435.651
40 ModeLT# = 1705.356
50 ModeSB# = 2400.664
60 ModeST# = 1965.11
70 CLS:Print "Copyright 1989 by David G. Hart, AA6CQ/VE6"
80 Print "OSCAR-13 Doppler Shift Calculator"
90 Print "Select Mode (B,L,S) ";
100 Mode$ = Input$(1):Print Mode$
110 Print "Enter Received Beacon Frequency (MHz) ";
120 Input RXBF#
130 Print "Enter Received Station Frequency (MHz) "
140 Print "To exit enter a number less that 14"
150 Input RxSF#
160 If RxSF# < 14.0 then GOTO 410
170 IF Mode$ = "S" or Mode$ = "s" then goto 230
180 IF Mode$ = "L" or Mode$ = "l" then goto 270
190 RV# = ((RXBF#-ModeBB#)/ModeBB#)*300000.0
200 SatTxF# = (RxSF#/(1+RV#/300000.0))
210 SatRxF# = ModeBT# - SatTxF#
220 GOTO 300
230 RV# = ((RXBF-ModeSB)/ModeSB)*300000
240 SatTxF# = (RxSF/(1+RV/300000))
250 SatRxF# = SatTxF - ModeST
260 Goto 300
270 RV# = ((RXBF-ModeLB)/ModeLB)*300000
280 SatTxF# = (RxSF/(1+RV/300000))
290 SatRxF# = ModeLT - SatTxF
300 Uplink# = (SatRxF#/(1+RV#/300000.0))
310 CLS
320 Print "YOUR UPLINK FREQ  = " ;
330 Print Using "####.####";Uplink#
340 Print "Your Receive Freq = ";
350 Print Using "###.####";RxSF#
360 Print "Relative velocity =";
370 Print Using "+####.##" ;RV#;
380 Print " km/s"
390 Print
400 GOTO 130
410 CLS:Print "Goodbye":END
```

BASIC program for calculating Doppler shift for the six different modes.

shifted by 1500 Hz. In fact, your Mode B uplink frequency will be shifted by 4500 Hz. For example, if you hear a station on 145.905 MHz, the satellite is actually transmitting 1500 Hz LOWER at 145.9035 MHz. As OSCAR-13 Mode B is an inverting repeater with a translation frequency of 581.398 MHz, the satellite must receive a frequency of 435.4945 MHz to transmit at 145.9035 MHz. At any point, the sum of the satellite's received frequency and the satellite's transmitted frequency is always 581.398 MHz.

Uplink Shift

Since the satellite must receive a frequency of 435.4945, we must transmit a signal that allows for the Doppler shift. To calculate the ground transmit frequency (f_g), place the satellite receive frequency and the *Vr* into the Doppler shift equation and solve for f_g:

$$435{,}494{,}500 = f_g + 3.09\,(f_g/300{,}000)$$

$$f_g = 435{,}490{,}000$$

Thus to receive on 145.905 MHz, you would transmit on 435.490 MHz. The uplink Doppler shift is 4,500 Hz down while the downlink shift is 1500 Hz up, for a net shift of 3,000 Hz down.

You might notice that the total shift is twice the apparent shift of the beacon in the opposite direction. You can follow this rule for all OSCAR-13 Mode B operations: *The total shift is equal to twice the opposite beacon shift.* If the beacon frequency is shifted by 1000 Hz down, raise your transmit frequency by 2000 Hz.

IF you wanted to put your receive signal on 145.8 MHz, without Doppler shift you would transmit on 435.598 MHz. However, if the beacon is shifted 2000 Hz UP, the transmit frequency would be shifted 4000 Hz DOWN, to 435.594 MHz.

Mode L and Mode S Rules

Using the Doppler formula, you can also work out the rules for Mode L and Mode S. Mode L is also an inverting repeater (with a translation frequency of 1705.356 MHz) with a rule similar to Mode B: the total shift is equal to 1.9 times the opposite beacon frequency shift. If the beacon shift is 3000 Hz UP, you must shift the actual transmit frequency 5700 Hz DOWN. This rule is not exact, but it is close enough for government work.

Mode S is a non-inverting repeater (with a translation frequency of 1965.11 MHz) so the rule here is a little different: The total shift is equal to 1.2 times the beacon frequency shift. If the beacon is shifted 10,000 Hz UP, you must shift the actual transmit frequency 12,000 Hz UP.

The rules are a result of translation frequencies, repeater types, and uplink/downlink frequencies, and not just whether the mode is inverting or not.

Let The Computer Do It

Because Mode L and Mode S rules are not exact, I have included a simple BASIC program to aid in exact shift calculations. The program is also for those of us who can't do simple math. The program assumes you are using OSCAR-13.

To use the program, either run the compiled version or load the code into your BASIC interpreter. The program will ask you for your operating mode (B,L,S) and the measured beacon frequency. The program will then ask for the received frequency that you want to wind up on. Your transmit frequency will then be displayed along with the relative velocity, *Vr*.

The program should run on most computers having BASIC. The source code and compiled version is available on Compuserve (in the Hamnet conference) or from the author (in MS-DOS format on 5¼" or 3½" diskette) for US $5.00. If you get the program from the author, a more sophisticated version will be included with the simple version. Contact AMSAT for information on commercial software or join the Hamnet conference on CompuServe.

OSCAR-13 really adds an exciting new mode of communications to the amateur world. By monitoring the beacon frequencies on the satellite, you can use these simple rules to find your signal the first time, every time. This is especially easy using Mode B since your transmit frequency shift is just twice the opposite of the beacon shift. So have fun and happy satelliting!

JEZ—Jugendelektroniczentrum

How one Swiss group supports the education of young hams.

by Ruedi Mangold HB9DU

I have been a ham since 1930. At first, I did shortwave listening, but in 1938 I got my amateur license. Then, during WW II, I was in the Swiss Army Signal Corps, repairing equipment. After that I taught physics at the Basel technical college.

But we always come back! Recently, I began teaching amateur radio, 30 adults at a time, using my excellent physics equipment and the college physics auditorium. Candidates for licenses were tested by our experts from the PTT (like the American FCC) from Berne, and they got the highest percentage of passing grades in Switzerland—86% of them correctly answered the required 70% or more of all the questions!

Photo A. From left to right: Ruedi Mangold HB9DU, founder and spiritus rector of JEZ; Christine Wirz-v. Planta, president of the supporting club; and Christoph Biel HB9DKQ, technical chief of JEZ. (Copyrighted photo by Andre Muelhaupt, Basel. Published in Basler Zeitung: 17.3.1988.)

This was, we here all agree, because the course included lectures, films, experiments, what you call "hands-on" training, and visits to Swiss transmitting stations. It was a real triumph for them, for our PTT is a hard taskmaster in every respect.

PTT Rules and Regulations

Some who have worked HB stations have perhaps thought Swiss hams curt and impolitely short. Please do not think so. It is because a ham is likely to be punished should he talk more than, say, ten words about the weather. The PTT listening, or control, stations are severe supervisors. You are allowed only conversations about technical topics and "information of negligible value, for which the use of the telephone is not justified." Third party information "is strictly forbidden."

Furthermore, there is no protest allowed against any PTT verdict. In the Swiss Constitution, the PTT is given absolute monopoly over all communications. And since there is no exact definition of forbidden conversations, the Swiss ham, as we say, "always has one of his legs in the law courts!"

The first license in Switzerland was issued to H. Degler in 1926. His call was H9XA. When the Union of Swiss Shortwave Amateurs, the USKA (our version of the American ARRL) was formed in 1929, there were 35 amateurs. Today we have over 3,500.

Testing Requirements

They all passed the tests. For the "small license," meaning you can send on 144 MHz and up (200 W PEP for the first three years, then 1,000 W PEP), the tests are:

(1) 20 multiple-choice questions—most about complicated algebraic problems in general electronics, and on receiving and transmitting techniques—to be answered within 60 minutes.

(2) 20 questions on international regulations, codes, and security regulations.

(3) 10 questions on antenna-building regulations. (Switzerland is a highly electrified country with a rather dense telephone network, and severe laws about the protection of landscapes.)

For the "big license," allowing use of the short waves, you also must pass the Morse exam. For a five-minute period you must work at 60 characters-per-minute (12 wpm), transmitting and receiving in mixed languages with no more than three errors.

Exam questions change with every test, and there is no book of past questions you can study. Candidates *must* have a thorough understanding of electronics. This is why we have courses which run for three semesters, two hours per week.

Now you see why my candidates were so proud of themselves!

Formation of JEZ

I was able later to have classes for youngsters, ages 14 to 18, using my college facilities, but having the Basel Education Department pay all of their expenses. There were nine courses, three of them for kids, by the time I retired in my sixties. And then, having seen the very big need to help introduce youngsters to the world of electronics and amateur radio, in 1974 I founded JEZ—the Jugendelektroniczentrum.

Within months it was clear that leisure-time courses would not be enough and community involvement was called for. The local radio club, the Funkamateur Club of Basel (FACB), pitched in. An unused kindergarten building was obtained; it was located on the second highest point in Basel, surrounded by meadows where antennas could be erected. Ten FACB members put in 1600 hours of volunteer time and installed electricity and plumbing. The town's chemical companies donated furniture, a chain-store company (the Migros) donated tools, and factories gave dozens of measuring instruments, including multimeters, spectrum analyzers, a sheet metal bending machine, and lathe and turning tools. The library stocks 10 different European and US electronic journals, and there are drawers that contain over 8,000 different components. In this self-service system, students pay for what they use when they leave the workshop.

By the mid-1980s we were offering courses (much less expensive than the usual $230 for school boys to learn about ham radio) in a

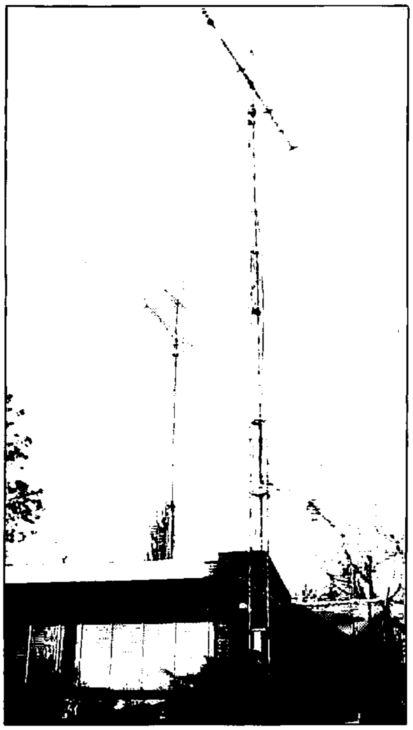


Photo B. JEZ antennas: twenty meter mast with beams for 2 meters and 70 cm; satellite antennas and a Windom above for 40/80 meters; Versatower with DJ2UT beam in foreground. Not visible: Meteosat and ATV receiving and transmitting antennas.

variety of subjects in the field of electronics. As of 1988, some 40 youngsters were taking courses weekly. About 20% of them will become interested in ham radio and the others will get very good jobs in the electronics industry. We don't just make amateurs, we make motivated youngsters for high tech fields.

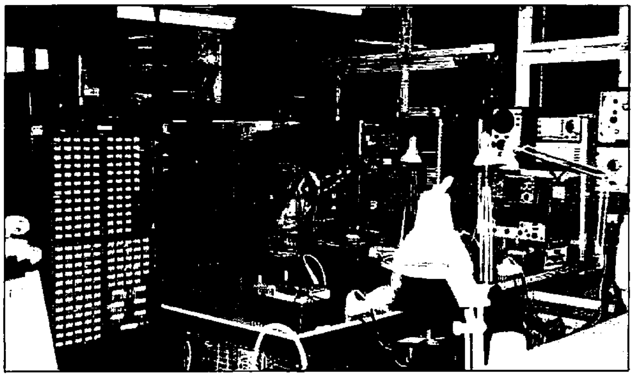


Photo C. At left are resistors and condensers; window shelves hold spectrum analyzer. Also shown are frequency generator (10 Hz to 12.6 GHz), frequency counters, and oscilloscopes.

Because the response to our center was so great, and the task too much for volunteers from the 80 member FACB, we had to organize more formally. We now function with the government giving us rent-free space and an annual contribution of 55,000 Swiss francs (about $39,000), and we have a supporting club, the "Trägerverein JEZ," presided over by a prominent Basel Member of Parliament, Mrs. Christine Wirz-v. Planta. We have private donations which also amount to 55,000 SFr. and a working crew which includes six instructors, and other volunteers who help keep the center tidy and the equipment working. Christoph Biel HB9DKQ is the JEZ chief instructor now, and I am a helping hand for him. (I sometimes say that HB9DKQ is now the conductor, and I am only the semiconductor!)

In A Word: Meaningful

We have now a serious learning center with a friendly atmosphere. The youngsters cannot just come and go as they wish. We have a nice cafeteria and a well-stocked library, and the best of equipment and the best sponsors. The electronics industry has been saying to me that we provide them with the best technicians.

I am afraid nobody often hears the HB9DU call any more; I am too busy. But in my choice between being an Elmer for 40–50 youngsters and a DX chaser, I have taken the route that is eminently more satisfying . . . 73

Need FM?

FM demodulation circuit for older receivers.

by Walter Symczyk KB2BQK

Phased-locked loop (PLL) integrated circuits can enhance the capabilities of older equipment. With the recent increase in FM activity on the 6 and 10 meter bands, I began looking for a way to monitor this activity. My station did not support either band. I monitored the 6 and 10 meter bands with my Hammarlund HQ-170-A, but this receiver didn't demodulate FM.

The Mod

I decided to use a PLL IC to demodulate FM signals from the IF strip of the Hammarlund. The IF frequency of the Hammarlund HQ-170-A is 455 kHz. A phono plug on the rear of the receiver allows access to the IF strip. The IC chosen for this task was a NE-565-N which has a frequency range from 0.001 Hz to 500 kHz.

This IC, readily available for less than five dollars, consists of a phase detector, VCO, and amplifier. For projects with receivers of different IF frequencies, you may need a different IC. For example, the NE-560-B has a frequency range of 1 Hz to 15 MHz. (Please note that the internal configurations and pinouts differ on these ICs, but you can otherwise apply the concepts in this article.)

How Demodulation Occurs

The operation of this IC is controlled by the following external components: C1 and R1 control the free running frequency of the VCO, and C2 controls the capture range (the range over which the PLL acquires phase lock). To demodulate FM, set the free running frequency of the VCO to the frequency of the receiver IF, and set the capture range to approximately the width of the signal you wish to demodulate.

Connect the VCO to the phase detector through pins 4 and 5. Connect the input signal at pin 2. The demodulated output is presented at pin 7; it is the correction voltage which keeps the VCO locked on the input signal. In other words, the phase detector compares the input signal with the signal generated by the VCO and generates a correction voltage for the VCO. This correction signal is amplified internally and fed back to the VCO to maintain the lock. It is this correction signal which provides the demodulated output.

The design formulae used with the 565 are:

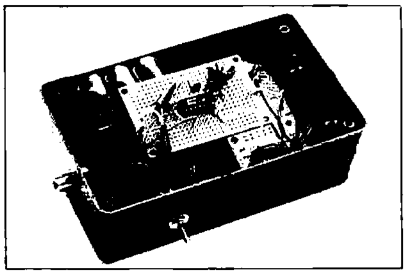


Photo A. Assembled FM demodulator.

Parts List

U1	NE565N	
C2	0.1 µF ceramic	
C1A	100 pF ceramic	C1A & C1B used in parallel to obtain 127 pF
C1B	27 pF ceramic	
C3	0.001 µF ceramic	
R1	10k variable	
R2	5230Ω	

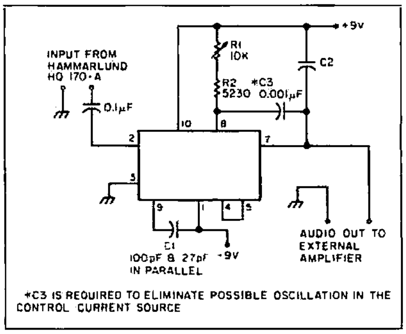


Figure 1. Schematic of the FM demodulator.

Free-running frequency of VCO: $f_O = 1.2/4(R1)(C1)$

lock range $f_L = \pm 8f_O/V_{CC}$

capture range $f_C = \pm \frac{1}{2\pi}\sqrt{\frac{2\pi F_L}{r}}$

where $r = (3.6 \times 10^3)(C2)$

Now for the real world: Armed only with a poorly supplied junk box, IC spec sheet, frequency counter, *ARRL Handbook* and a Heathkit HO-5405 station monitor scope, I first assembled an oscillator circuit using a 555 timer IC. This circuit was running at about 350 Hz. Then I set up the 565 to lock on the signal generated by the oscillator. I observed all the inputs and outputs until I was comfortable with the operation of the 565 IC. What I learned at this stage was invaluable for later debugging. I highly recommend that anyone doing a project of this nature go through this exercise.

Figure 1 is the circuit I came up with, and which I am currently using. The component selections were all compromises based upon what was in my junk box. Therefore, in many areas there is room for optimization. I constructed and tested the circuit on a breadboard. When I finished playing with it, I moved it to a PC board using ugly construction.

Solving the Problems

The first problem I encountered was insufficient signal strength at the phone plug IF tap of the HQ-170-A. To solve this problem, I changed the tap point further down the IF strip where a stronger signal was available.

The second problem was tuning the circuit. I accomplished this by setting the 565 VCO free running frequency with a frequency counter to 455 kHz, adjusting R1. To do this, remove the jumper between pins 4 and 5, and ground the input pin 2. I also used a filter capacitor which allowed a capture range of ± 13 kHz. I connected everything up to the Hammarlund. When I was satisfied that the circuit was locking on signals (this required some fiddling with R1), I replaced the filter capacitor with one which provided for a capture range of ±4.2 kHz.

After everything was running, the audio required external audio amplification. In regards to performance of this circuit I observed that signals received with a strength of S-5, as indicated by the Hammarlund's S-meter, are full quieting. I believe that the circuit could also be improved by a better choice of components and the addition of an external amplifier stage prior to the PLL.

If you have an older receiver and you can spare the cost of the IC, I think you'll find this an educational, entertaining, and rewarding project.

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The ARRL Handbook for the Radio Amateur, American Radio Relay League, Newington, 1985.

10 GHz RF Preamp

A building block toward a complete 10 GHz transceiver system.

by C.L. Houghton WB6IGP

Construct an amplifier for the 10 GHz microwave band? How about 18 dB gain and 3 dB noise figure at 10 GHz? Does it sound impossible? Well, it isn't! San Diego Microwave Group members have constructed several of these amplifiers and all have worked quite well. Thanks to Clark Bishop WB4PQD, who designed this stable, high performance, dual-mode amplifier for 10.12 GHz, and who is allowing us to publish the design for amateur use.

Preamp Construction

The amplifier described here has been used as a receiving preamplifier and as a transmit amplifier, with appropriate RF relay switching. Construction of this amp is somewhat delicate due to its small printed circuit board and components. The finished PC board is 1½" by 1" (see Photo A).

Mitsubishi's low-cost (about $15 each) Gallium Arsenide Field Effect Transistor (GaAsFET) MGF-1402 is central to the preamplifier's design. It has gold metalization strapping over the ceramic case, connecting the two strip line opposed source leads. Most importantly, this metalization reduces the total inductance of the source leads necessary for good operation at 10 GHz. When ordering, be sure to specify the full gold metalization over the case connecting the source leads together.

In other designs, the emitter or source leads are bent down and over to connect to the rear ground foil. At lower frequencies, this works well, but at frequencies above 5 GHz, a very small inductance in the leads will give low gain and the amplifier may become useless. Lead length is critical for proper operation. See Figure 1 for the schematic and parts placement.

The Teflon™ PC board is 0.031" thick, with a dielectric constant of 2.5. You will need Teflon stock because other materials will not perform at microwave frequencies. If you can not find any Teflon, or just don't wish to make our own, I will provide the etched PC boards and/or a minikit of parts.

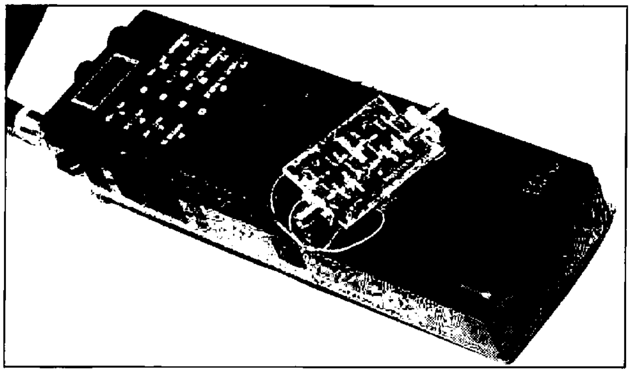

Photo A. Close-up showing the 10 GHz preamp on top of an IC-02 battery box for size comparison. The amplifier uses two MGF-1402s and boasts only 3 dB noise figure and 18 dB gain.

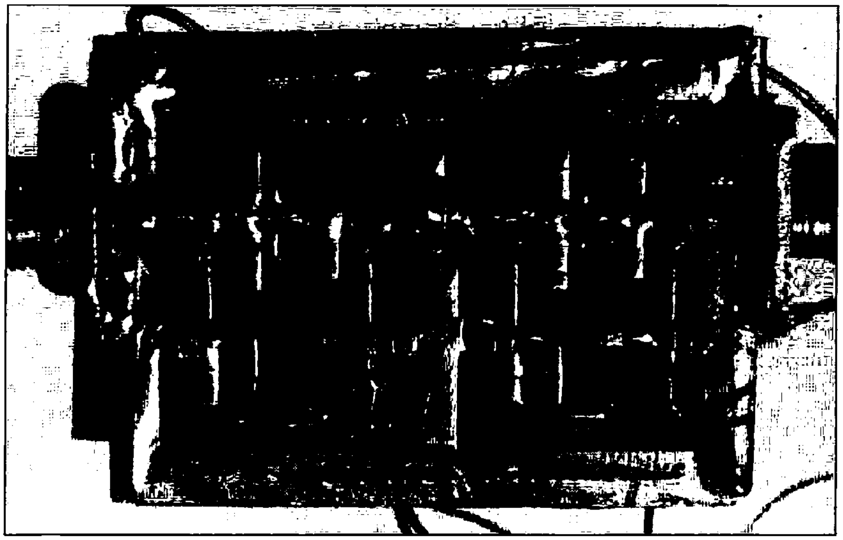

Photo B. N6IZW's 10 GHz pre-amp. GaAsFETs are mounted upside down, under the "W" and "N" in the callsigns. Coax connectors are SMA.

The amplifier is a two-stage device requiring a small power supply with negative bias and positive drain. Current demands are light. The external power supply that I built furnishes a bias of −1 volt DC and drain voltage of +4.5 volts. You could use an AA battery for bias and an adjustable regulator for the drain voltage (see Figure 2).

Building the Power Supply

I decided to build a power supply that provided sequencing protection, as Ray W6AMD suggested. By putting a series pass transistor in the positive input circuit, the positive voltage will not activate until the bias supply is operating at full potential (see Figure 3). I have used this protected power supply for months, and it has proven reliable. It runs from a 12 volt supply. The negative power supply is enclosed in a small 24-pin DIP package and looks much like a large EPROM. The transformer-isolated power supply is regulated to −9 volts with 40 mA of current available.

We only need a few mA, so the power supply loafs in this application. Part of the negative supply is voltage divided to the −1.2 volts to feed the gate bias circuitry. This requires very little current. The main −9 volt output is fed to a series current limiting resistor in series with a 6 volt zener diode, which in turn feeds the emitter of a 2N2222 NPN transistor.

Tie the collector of the 2N2222 to the base of the 5 Watt dissipation PNP pass transistor which controls the input of the LM-317 positive adjustable regulator. When you apply +12 volts to the power module, the negative power supply turns

on, producing −9 volts output. This negative voltage passes through the 2N2222 switching transistor, and turns on the base of the pass transistor, a 2N5322. If for some reason the negative voltage isn't high enough to overcome the series resistor and zener, or if it fails to come on at all, the positive supply will not come on, either. This prevents the positive supply from applying voltage with zero bias on the FETs. There are 100Ω in the drain leads to further protect the FETs, so this is just additional protection. More than 6 volts can destroy FETs, so this rating should never be exceeded. I placed 5.6 volt zeners in both the negative and positive power supply outputs to prevent any possible problem. I modified the PC board to accept 5 Watt zeners, which should fold down the power supply in case of overvoltage.

Mounting the Components

The components to be mounted on the amplifier board are all chip type resistors and capacitors. The chip resistors, of which you need four, are 100Ω. Three 1 pF ATC-100 type chip capacitors are used to connect the input, output and interstage coupling. We have used values up to 2 pF with little change in performance. The bypass capacitors, of any value from 100 pF to 1000 pF, are chip type.

Prepare the PC board by cleaning it with fine steel wool. Apply a small dab of liquid rosin to the spot where you want to solder a chip component. This will hold it in place while you solder. You can use a toothpick to position the chip resistor or capacitor and to hold it down so you can solder only one end of the device. Then you can solder the other end. A chip soldered on both ends is difficult to reposition.

By the way, I recommend a temperature controlled, low voltage iron, such as a Weller WTCPS soldering station. They're grounded, a requirement for working with the static-sensitive GaAsFETs. If you don't have one, unplug your soldering pencil and ground it when soldering GaAsFET devices.

Position and solder all chip capacitors and resistors on the front face of the PC board. Solder a grounding foil around the outside of the PC board edges. Cut out the top foil where the SMA coaxial connectors will be mounted, to give clearance to the center conductor of each SMA connector. Solder the ground foil and the ground part of each SMA connector together, on top of the board. This makes a short ground connection to the outer perimeter of the top of the PC board, and a solid connection to the rear ground foil surface.

Now, make the cutouts for the FETs in the circuit board and rear ground foil, clearing a hole about 0.100" square to fit the FET. The case size of the FET is specified at 0.071". The hole should allow easy entry of the FET on the PC board when you're ready to solder the device. The FET is mounted upside down on the PC board (see Photo B), allowing the top of the FET (part of the strip line source connections common to the FET) to be

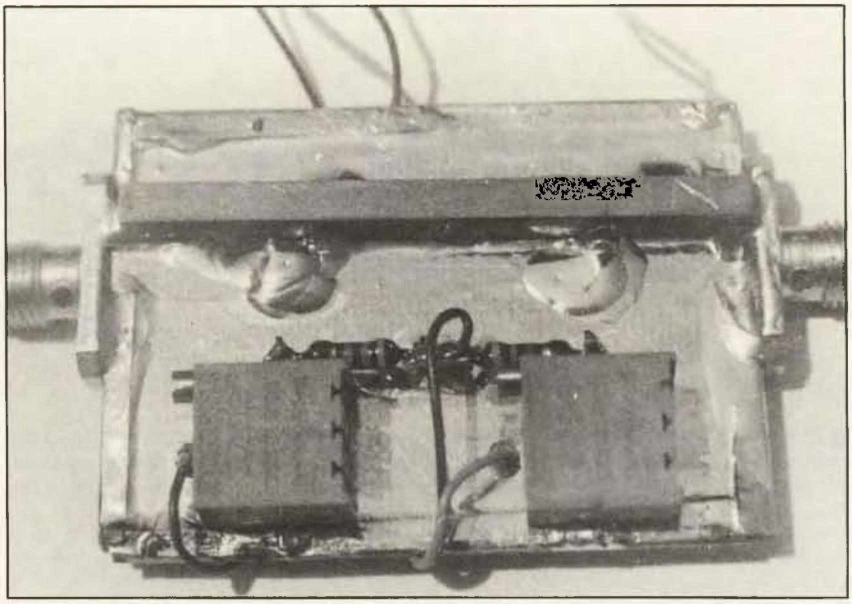

Photo C. Rear view of the 10 GHz preamp, showing the mounting arrangement of bias adjustment pots, and the brass bar which strengthens the soft Teflon PC board.

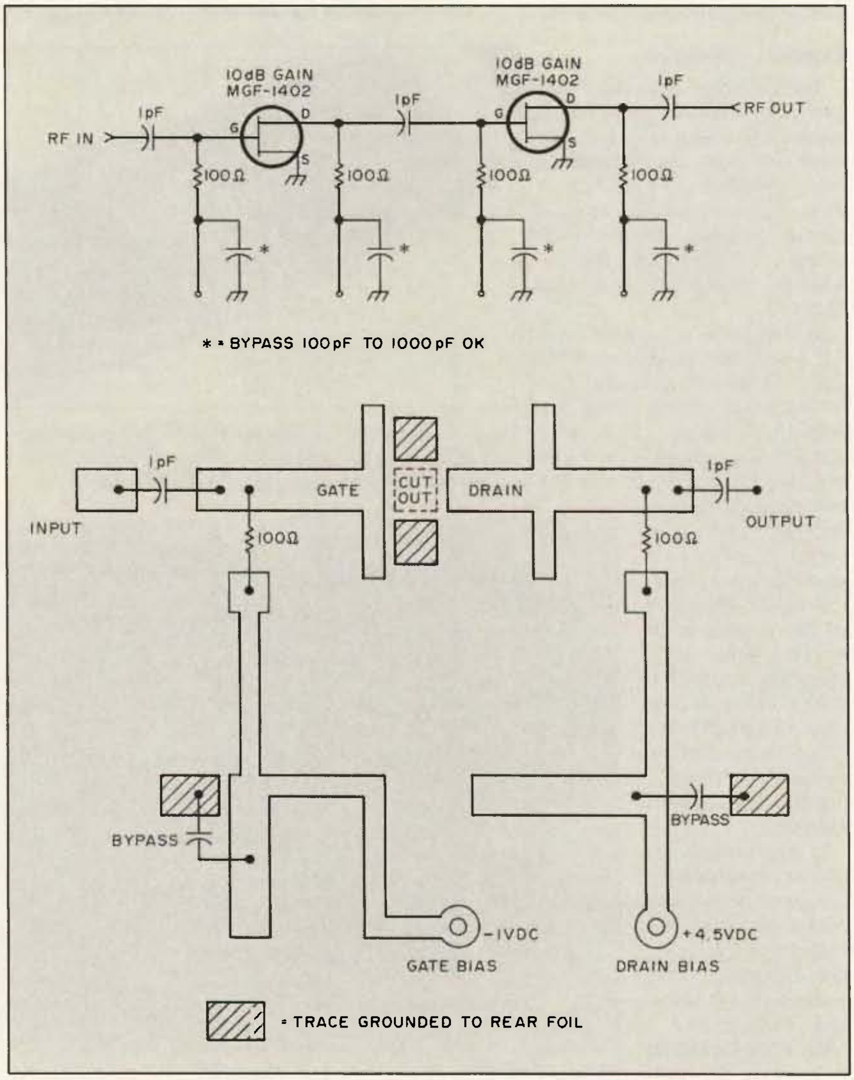

Figure 1. 10 GHz preamp schematic and parts placement diagram.

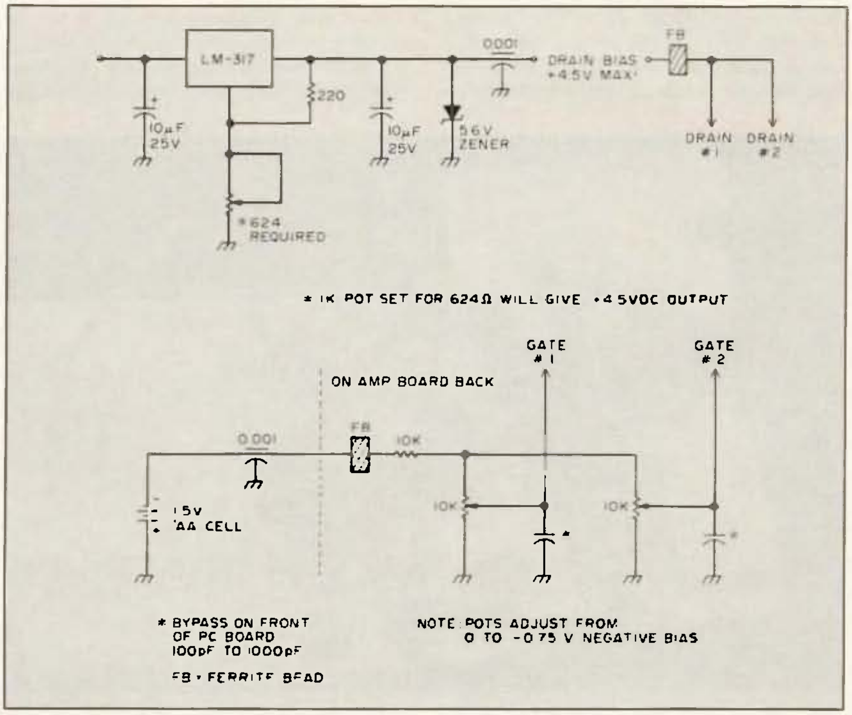

Figure 2. Power supply with battery for the 10 GHz preamp.

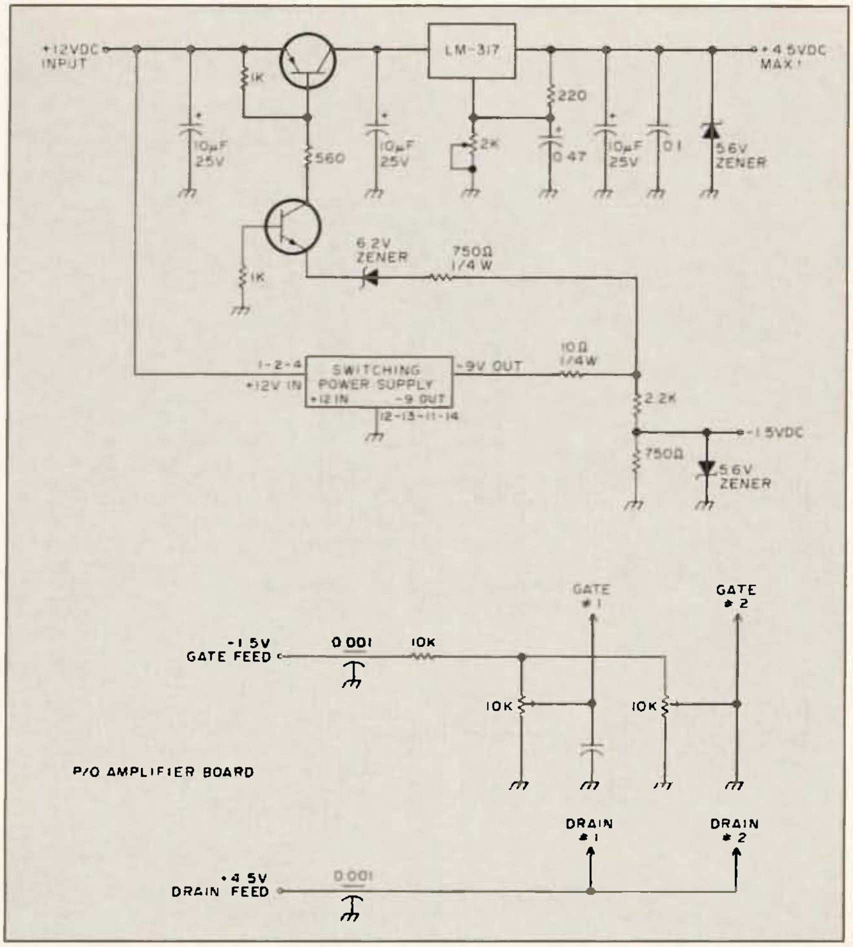

Figure 3. Power supply for preamp. Supply provides sequencing protection. The schematic below the power supply schematic shows where the power supply leads attach to the amp board.

soldered to the rear ground foil. This makes the short source leads required for this frequency. Do not mount the FETs now.

Next, mount the bias adjust circuitry, two 10kΩ pots, on the back of the board. Pass the wiper of each pot through a small hole in the ground plane so that it contacts the bias feedpoint for FET#1 and #2. The opposite end of the adjustable potentiometer is grounded, and the high end is tied common to each other with a 10k ¼ Watt resistor in series with the bias supply. Place a small insulator under the pots to prevent the top negative supply point from possibly touching ground with any downward pressure on the pot. Tie the two drain lines common, on the back of the board.

When all components are mounted and the FET cutouts made, check the board carefully, then insert the GaAsFETs, one at a time, into the board. Use a grounded soldering station, and don't forget to ground yourself to the work piece. A wrist strap of high resistance, but sufficient to discharge any static from yourself, is available from many dealers. This is necessary to prevent damage to the sensitive FETs. If you take these precautions you should not have any trouble. Just work slowly and carefully, and keep all components grounded.

Final Check

In this last stage, pre-set the bias pots to maximum resistance, or maximum negative bias, to limit the FETs' drain current. Apply negative bias to both FETs, and while watching the first stage with a current meter (I used a 0 to 100 mA meter), adjust the associated bias pot to a drain current reading of 10 mA. (For the preliminary check, you might want to start with a positive DC voltage somewhat less than 4 volts.)

The first stage current of 10 mA is consistent with minimum noise figure according to the gain versus noise figure curves. Stage two is adjusted in the same way, except that you should adjust for a current reading of 20 mA. Higher current is not necessary, as the device is operating at optimum performance at this current level. For fine tuning anomalies, you may affix small pieces of copper to a toothpick and move around the traces of the PC board. We did not perform this step because we were satisfied with the gain we obtained. It was stable and very near optimum.

When you are satisfied with the operation, you can adjust the bias to minimum current and re-set the positive DC supply to 4.5 volts. Go through the same procedure to set current levels. Do not apply DC voltage, negative or positive, above 5 volts because 6 volts will destroy the device. Go slowly, don't rush, and think your operations through. You can measure three times, but you can cut only once.

After the final checkout, put a short piece of scrap brass on the back of the PC board, over the soldered connection for the FET source case lead (see Photo C). Mount the brass to clear the other parts, and solder it between the two SMA flanges and the ground

foil. This will reinforce the Teflon PC board. House the amplifier in a suitable, shielded container along with the power supply (see Photo D).

Performance

From use, we know the amplifier is quite stable, with a good performance record. Most of the units we built varied due to different construction techniques, but they all gave close to 18 dB gain. The amplifier as both a receiving and transmit amplifier gave very good results. In transmit, the maximum output we obtained was +8 dBm as read on my HP-431 power meter. Kerry N6IZW and I feel that this is due partially to the fact that the 100Ω drain resistor on the output stage limits the device. We plan to try changes by setting bias and replacing the 100Ω resistor with a RFC. This will require further experimentation.

We made the relay switching scheme with four relays which happened to be the only microwave relays in our junk box. You can use other types, but check their loss, as the ones we used were less than 0.1 dB connection loss per contact. Cross isolation was excellent; loss from coupling from one operated side to the non-operated side was in excess of 50 dB. All interconnections were made with 0.141 coaxial hardline and SMA coaxial connectors.

The outline in Figure 4 shows our complete SSB system for 10 GHz. Other major parts of the system are the mixer and phase locked microwave oscillator. We obtained the latter from surplus. You can buy or build the the mixer. In another article, I will cover these items in detail.

Conclusion

Construction of this amplifier will give you a very good preamplifier and versatile device for 10 GHz microwave band operation. We have also used this device on our spectrum analyzer to improve system sensitivity.

PC boards for the 10 GHz amplifier are available etched and ready for mounting parts, with the ground foil, for $10 each postpaid. A kit with the chip resistors and capacitors, SMA connectors (2), ground foil and PC board, is $20 postpaid. The switch mode power supply module is $5. Specify 5 volts or 12 volts input. The MGF-1402 GaAsFET is available from *Microwave Components of Michigan, 11216 Cape Cod St., Taylor, MI 48180. Tel. (313) 941-8469 (evenings only).* Or call any distributor who carries Mitsubishi GaAsFETs. Cost is less than $15 per device. I would be happy to answer any questions pertaining to microwave or related subjects. Please send an SASE for a prompt reply to *Chuck Houghton, 6345 Badger Lake, San Diego CA 92119.*

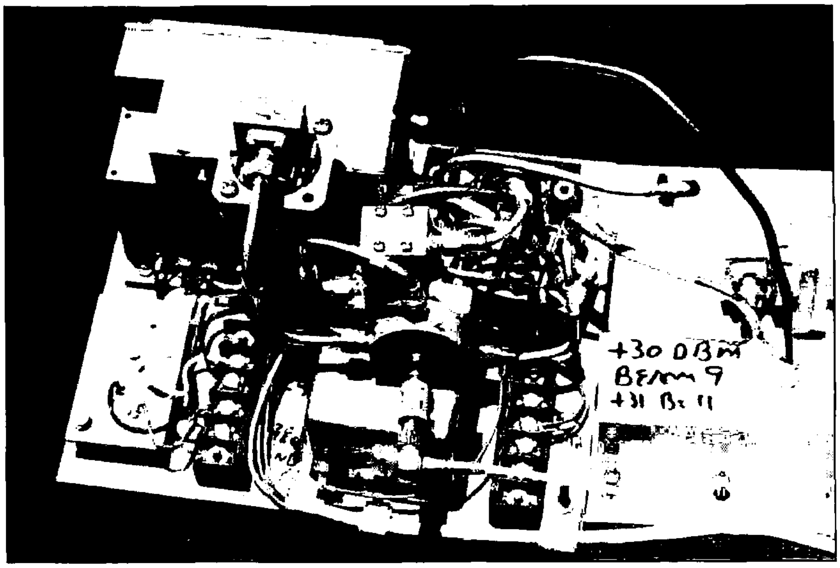

Photo D. 10 GHz SSB station WB6IGP uses 24 SMA connectors and 4 SMA SPDT 18 GHz relays. Preamp is inside the small bathtub-capacitor-looking shielded box. The large unit in the rear is the phase locked 10 GHz oscillator. See Figure 4 for block drawing.

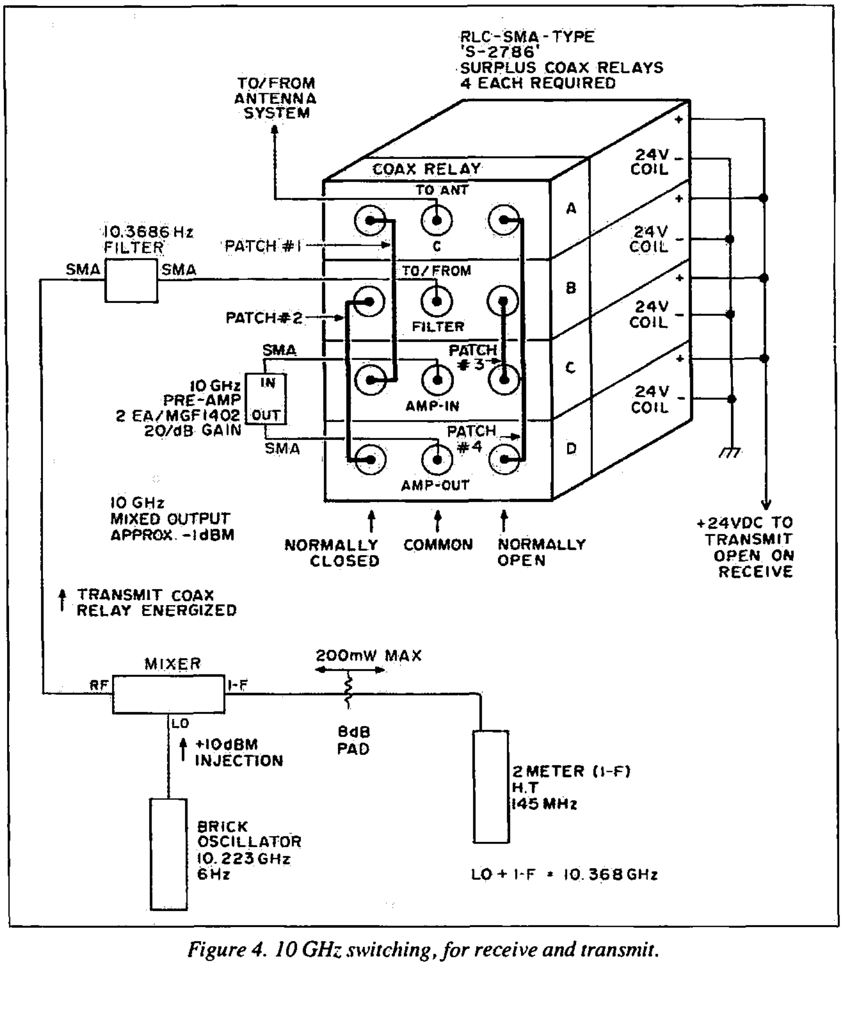

Figure 4. 10 GHz switching, for receive and transmit.

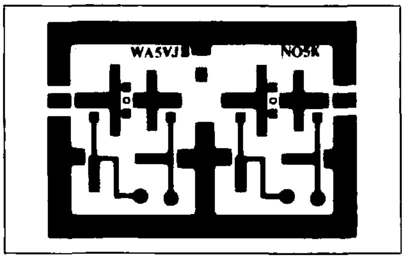

Figure 5. PCB foil diagram for 10 GHz preamp.

IF Shift, Cheap

Easy IF shift add-on to your older rig.

by Terry F. Staudt, LPE, W0WUZ

About 1980, passband tuning, or IF shift, was one of the first goodies to upgrade the transceivers of the late '70s in the A, S, or MK II versions. Most people with the earlier sets just figured it was another of life's insoluble problems, and let it go at that. After looking at several schematics, I came up with a coup. Not only is it possible to insert IF shift in these sets, it's easy and costs less than five bucks!

I'm going to show you how terribly simple it is to do. The only odd part is an outer tuning ring, which you can get from your manufacturer for a little over a dollar, if you want everything to match. Otherwise, anything will do.

IF Shift—What It Is

IF shift is simply a tuned circuit that uses a varactor diode, such as the Motorola MV 1872, or a general AFC unit made for FM home receivers. The circuit is in the secondary of (usually) the first IF transformer, the original components being re-connected to the far side of the added trimmer capacitor.

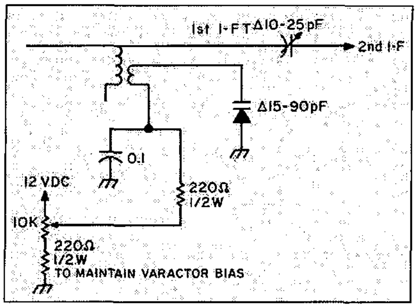

Figure 1. Schematic for the IF shift circuit.

The two 220Ω resistors are there to prevent failure from a bad varactor or the 10k linear pot parked at the far end.

I'm using a 25-year-old Galaxy 5 MK II, and the circuit works wonders. I got a "finger ring," as used on the RF gain at a hamfest, for a perfect match.

Recipe for a Tuned Circuit

Choose which control would be suitable, get the value from the schematic or measurement, and go to a parts house. Have them make you up a dual-ganged pot with the original value as the center control, and a 10k linear pot as the outer ring. Pick up the varactor, trimmer cap, and two 200Ω resistors.

Assembly and Adjustment

The schematic in Figure 1 is generally satisfactory for universal application. After installation, when you have taken an S-meter reading on 10 meters, you must make two adjustments. You also need to establish a 12 volt DC "pick-up" point.

First, with the new pot at 50/50, adjust the IF transformer for the highest reading. Second, adjust the trimmer cap for the same S-meter reading as before. Resist the temptation to go for more, as it would degrade the selectivity. Make these adjustments and the "benchmark" reading with the unit's calibrator signal. I chose 10 meters to avoid fooling around with a 20 dB over 9 reading.

So simple and yet so useful—don't know why I haven't yet seen it in print! 73

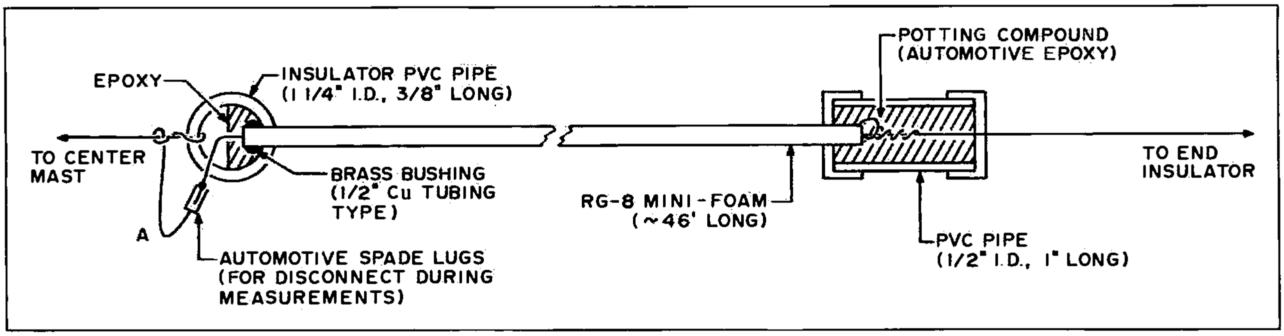

Figure 5. Quarter-wave phasing stub construction details.

continued from p. 26

terminating resistor should be changed from 50Ω to about 100Ω.

Because of the higher input resistance, wind a a toroidal matching transformer to match the 50Ω value at the transceiver. If possible, place these transformers at the tops of the masts at the feedpoints. If this is impractical, place the transformers at the feedline inputs with tolerable standing waves in the lines. Again, losses are low at these frequencies.

Physical Layout

Suburban plot limitations (about two-thirds of an acre) demand dimensional compromises. Figure 6 shows the original 2-element phased array for each dipole. The mast is assembled from aluminum irrigation tubing as described above, and the support posts are 2½" (i.d.) galvanized steam pipe.

The radiation capture area may greatly increase if the halyards, which are almost a quarter-wavelength long, could support radiator extensions. For example, if each halyard supported a half-wave element fed in-phase from the end of the corresponding radiator, we would have three half-waves in phase, instead of a half-wave basic radiator. Two of these makes up the 6-element phased array.

For this, I put together the quarter-wave phase reversing stubs, and connected them as shown in Figure 4. Since I had limited space, however, I couldn't extend the end sections the full 72 feet. I foreshortened these sections by adding inductive loading coils beyond the ends of the quarter-wave stubs. To reduce inductive loading and decrease ground losses due to penetration by the high E-fields at the ends of the radiators, I turned these extensions upwards to form vertical terminations above the support posts. I achieved this by clamping 10-foot lengths of 2"-PVC (i.d.) pipe against the support posts.

The coils were commercial units, 2½" in diameter. They slipped over and were supported by these pipes above the support post tops. 8½-foot long CB whips mounted on caps at the tops of the pipes terminated these extensions. See Figures 7 and 8 for details.

Again, the four quarter-wave phase reversing stubs were made from RG/8M Mini-Foam coaxial cable. I adjusted the lengths to resonance with a noise bridge. Due to the slight variations in dielectric constant, these

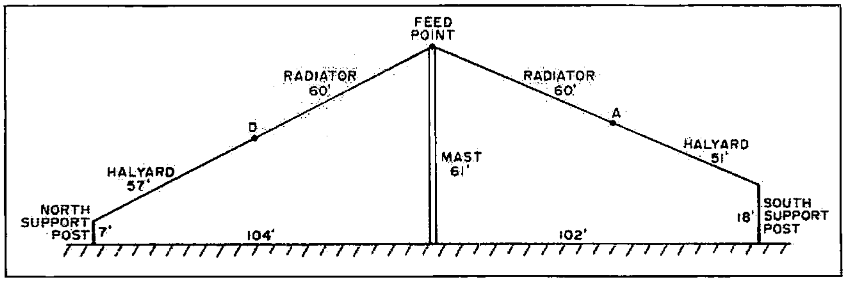

Figure 6. Original two-element phased array.

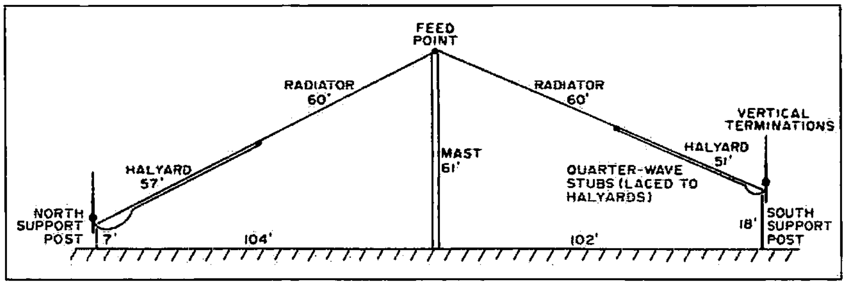

Figure 7. Modified array using inductive coils and vertical elements at the terminations.

lengths varied from 45 feet, 10 inches to 46 feet, 2 inches. The feedline polarity was such that, in this installation, the center conductors fed the south sections of the radiators, and the shields fed the north sections.

Setting the Coils

First, I checked the east and west dipoles for proper resonant frequency with the stubs and terminations in place, but with all of the spade lugs open. Then I connected the southeast stub and termination, and adjusted the southeast coil using clip leads until the resonant frequency was as desired (3.955 MHz in this case). For these measurements, I used a noise bridge at the input end of the feedline. Resonance occurred with 27 ¼-turns on the coil. The corresponding input resistance measured about 60Ω.

Next, I connected the northeast stub and termination and adjusted the northeast coil until I again reached the desired resonant frequency. This occurred with a northeast coil of 22 ¼-turns. The input resistance measured 110Ω.

I adjusted the west radiator system in the same way to yield the COCOA-3 arrangement. The measured resonance values were similar, with slight variation in coil turns and resistance, probably due to local near-field obstructions.

Toroidal transformers were wound as shown in Figure 9 to correct for mismatches in impedance and phase between the two radiators, and between source and radiator. The positions of the tap, *X*, and the preliminary value of the capacitor, *C*, which compensate for the inductive reactance of the transformer windings, were determined by noise bridge measurement using a load resistor of 110Ω. I completed the final trimming adjustment of *C* using the antennas as loads.

Results

After completing the resonating adjustments, I measured the SWR for each of the combinations corresponding to the seven positions of the phase controlling switch. The reflected indication was less than five percent of full scale for each of the combinations. This is far below 1.5:1 SWR for all settings. For the two separate COCOA-3 radiators, the indication was less than two percent of full scale.

The performance of the array with foreshortened radiators was evaluated in some detail using a receiver equipped with an accu-

continued on p. 78

AERIAL VIEW

Antenna News

Arliss Thompson W7XU
Route 1, Box 52
Colton SD 57018

Testing Coax

One of the most commonly used, and sometimes abused, items around a ham shack is coax. While open-wire lines certainly have their place, most of us use coaxial cable in one form or another to feed our antennas. Although it's relatively expensive, coax often doesn't receive much respect or attention once it has been installed. If your antenna doesn't seem to be performing the way it used to, perhaps the problem lies with the feedline and not with the antenna itself. Is your coax as good now as the day you bought it? How do you know?

None 100% Efficient

They're all losers. Regardless of price, no coax is perfect. They all have losses that arise from a number of sources. Two causes are the resistance of the wires making up the cable, and the effects of the dielectric material. These losses increase with the logarithm of the cable length and are expressed in decibels of attenuation per hundred feet of transmission line.

For any given coaxial line, the losses increase with frequency and SWR. Figure 1 shows typical frequency-dependent losses for a variety of common lines; Figure 2 shows increased losses due to standing wave ratios greater than 1:1. The losses caused by elevated SWR arise from increased losses in the conductors and in the dielectric. Conductor losses increase because currents are higher in lines with high SWR. Such lines also have increased voltages, thereby increasing dielectric losses. This situation may be expressed mathematically or, as in Figure 2, in graphical form.

Coaxial cable losses tend to increase with the age of the cable, particularly when the cable is used outdoors or is somehow abused. Cables equipped with PL-259 (UHF) connectors are particularly susceptible to water damage since that style of connector is not waterproof. Other environmental contaminants can affect coax by entering through the cable's outer covering. This is especially likely if the cable has a polyvinyl chloride outer jacket that is not noncontaminating. Try to use a noncontaminating jacket if you're going to bury the transmission line.

Measuring Losses

Ideally, check for coaxial cable losses when you first buy it, then recheck it at intervals thereafter. Rechecking every two years should be sufficient unless there is an obvious decrease in transmission line performance.

Testing new coax is relatively simple. All you need is a source of RF (your transmitter), a dummy load whose impedance is equal to the characteristic impedance of the line, and a wattmeter. With the wattmeter at the transmitter end of the line and the dummy load attached at the far end, apply power and take a wattmeter reading (P1). Remove the power, move the wattmeter to the dummy load end of the cable, and then, without making any changes at the transmitter, reapply power and note the new wattmeter reading (P2). You can determine the line loss from the equation: $dB = 10\log(P1/P2)$.

For example, assume you have 200 feet of RG-8 and you set up the test as described above. Let's say you apply RF to the coax and measure 10 watts of power at the output of the transmitter. You then move the wattmeter to the dummy load end of the line and reapply power. Now the wattmeter reads 8.3 watts. Using the equation above, $dB\ loss = 10\log(10/8.3) =$ 0.8 dB for 200 feet of cable. The

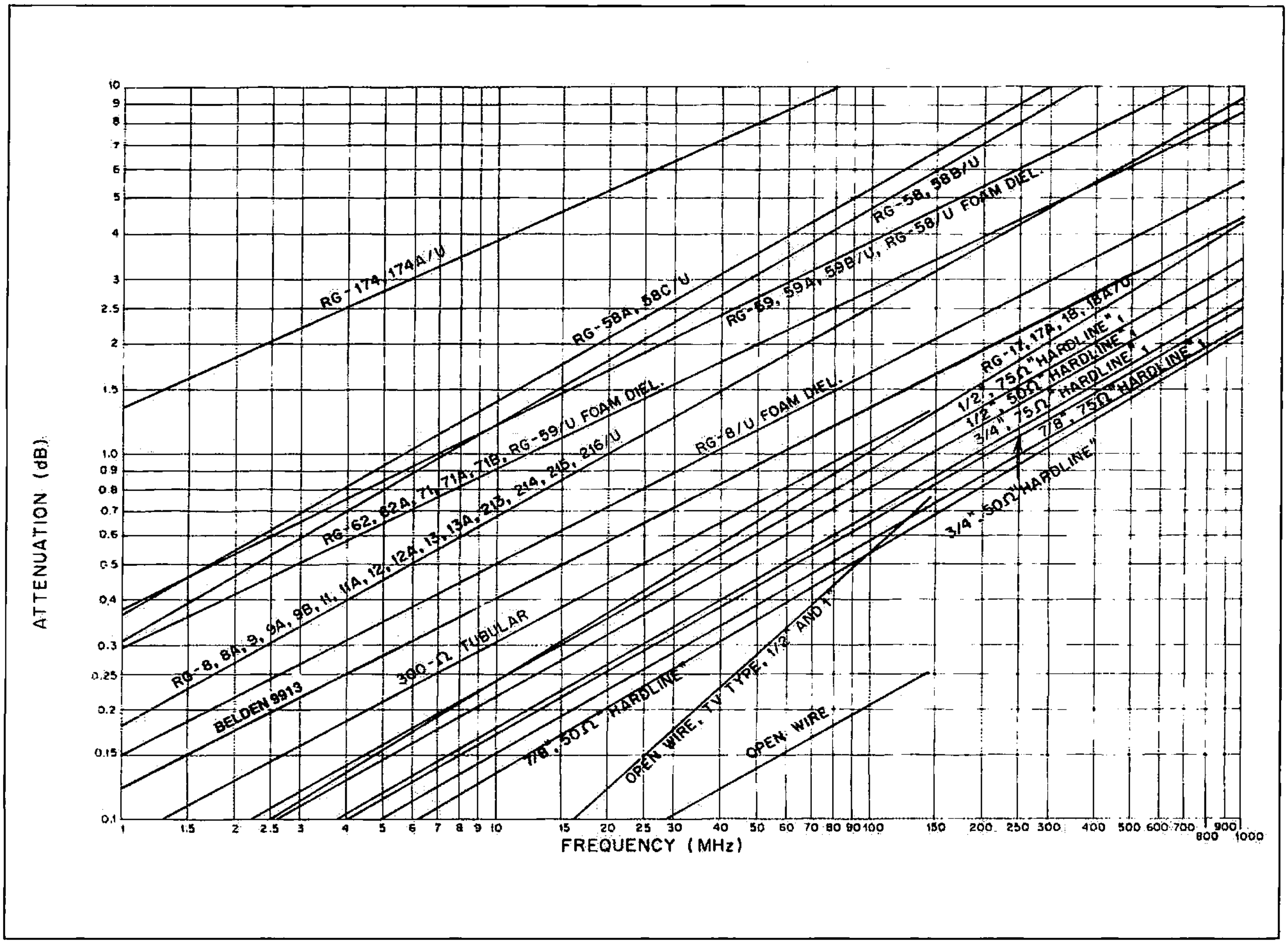

Figure 1. Attenuation in decibels per 100 feet for various common transmission lines (from the ARRL Antenna Book*).*

loss for 100 feet will be half of that, or 0.4 dB. Referring to Figure 1, you can see that the attenuation equals the specified value at 4 MHz.

Now let's assume that you have installed your coax, some time has passed, and you wish to confirm that the cable is still working as well as it should. You could bring the coax back into the house and retest it using the method described above, but that would not be very convenient if the feedline is securely fastened to the side of your tower. Another possibility would be to carry a dummy load and a wattmeter to the end of your feedline and go through the above procedure. Neither method is particularly convenient. Are there any alternative methods of measuring feedline losses? The answer is yes.

Other Ways to Measure Loss

One method that has appeared in the *ARRL Antenna Book* in past years is to create an infinite SWR at the far end of the transmission line and then measure the standing wave ratio at the input end. You can produce this infinite SWR by shorting the coax, or by creating an open circuit. If a line were very lossy, it would at least partially "hide" the very high SWR from the transmitter. The SWR as measured at the input would be much less than infinite. On the other hand, better lines (those with less loss) would indicate a relatively high SWR under those conditions since less of the reflected power would be attenuated by the coax. Thus, if you knew the SWR under those conditions and had the appropriate graph (such as curve E of Figure 3) or worked through the mathematics, you could arrive at the matched-line loss without heroic efforts.

There are some problems with this second method, however. See curve E on Figure 3. If matched line losses are low you will need to accurately measure some high SWR values. "High" in this case may mean SWRs of 20:1, 30:1, or even greater. For most of us those values of SWR are all tightly crammed together at the full-scale end of our SWR meters, and it isn't possible to measure them accurately. This method sounds good in theory, but it can be difficult to use.

There is still another way to determine line losses. Rather than creating an infinite SWR at the far end of the transmission line, place a load there that creates a finite SWR and then measure the SWR at the input. The load may be any non-inductive resistor; suitable values for 50Ω coax would be in the 150 to 500Ω, or the 17 to 5Ω ranges (to produce SWRs between 3 and 10 to 1). With this load at the far end of the transmission line, you can take an SWR reading at the input end and determine the matched line losses from a graph, or mathematically. Figure 3 shows matched-line attenuation versus measured SWR for standing wave ratios of 2:1 (curve A), 3:1 (curve B), 5:1 (curve C), 10:1 (curve D) and, as mentioned previously, infinite (curve E).

Here is an example. Consider the previous case of RG-8 coax. Suppose you used 100 feet of that line to feed a 75 meter inverted "V" supported near the top of your tower. You tested the coax before you installed it so you know that it originally showed 0.4 dB of loss per 100 feet at the high end of the 75 meter band. A few years have passed since then and you are curious to see if the line still works as well as it once did. The

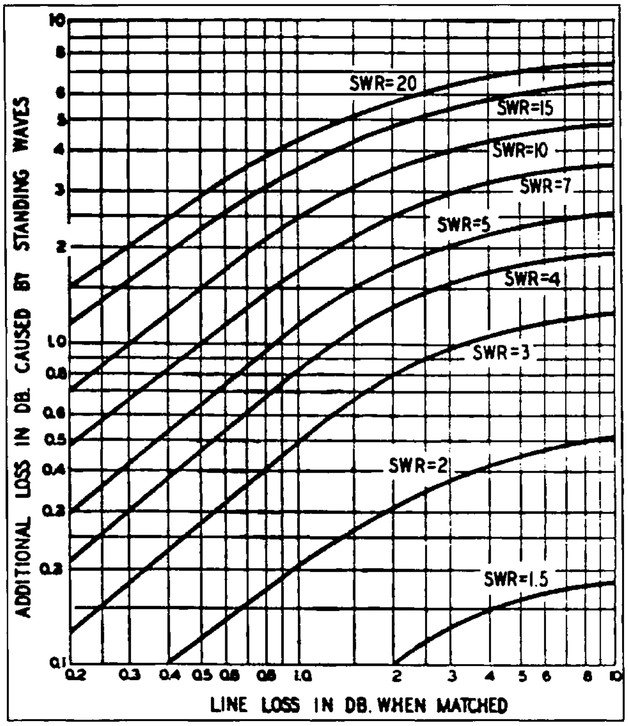

Figure 2. Additional line losses due to SWR greater than 1:1 (from the ARRL Antenna Book*).*

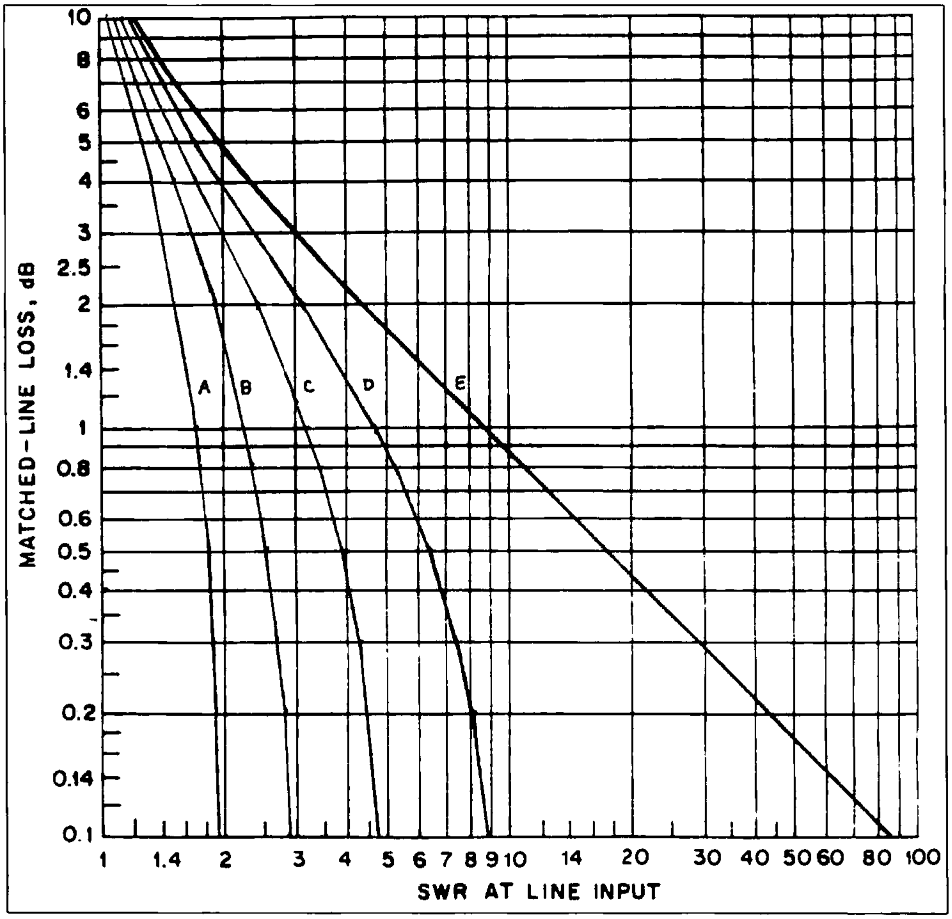

Figure 3. Matched-line loss versus SWR at the input (transmitter) end when the SWR at the load (antenna) end is (A) 2:1, (B) 3:1, (C) 5:1, (D) 10:1, and (E) infinite.

coax is buried between your house and the tower, then taped in multiple locations as it runs up the side of the tower. Bringing it inside for testing is out of the question.

After a bit of consideration you climb the tower to your antenna and disconnect the feedline, leaving the connector at that end dangling in midair. Returning to your shack, you apply just enough RF to operate your wattmeter and measure the SWR. The needle comes to rest somewhere between 5:1 and infinity, but with the meter scale the way it is you can't be much more exact than that. Referring to Figure 3, curve E, you see that the worst the matched-line loss can be under this set of circumstances is about 1.7 dB. That's not a major loss, but it is a significant change from the value you measured when the cable was new. Some authorities recommend that you should replace a line if there is an increase of more than 1 dB in the rated loss per 100 feet. At this point you need to more accurately determine the matched-line loss before you can make a decision about replacing the line.

There are two ways to proceed at this point. One way would be to leave the transmission line as is but repeat the SWR readings at a higher frequency. From Figure 1 you can see that the rated attenuation for new RG-8 at 144 MHz is slightly greater than 3 dB per 100 feet. When you check the SWR on this open-circuited line at 144 MHz you read a value of 2.5:1.

"For any given coaxial line, the losses increase with frequency and SWR."

Again referring to Figure 3, curve E, you see that the matched-line loss is in the neighborhood of 0.7 dB greater than it should be at that frequency. You decide that although the losses in the cable have increased with age, the actual attenuation on 75 meters (presumably slightly over 1 dB per 100 feet) is still low enough that you will continue to use the line for the time being. However, you make a mental note to test the line more frequently in the future.

Another possible solution to this problem would have been to place a noninductive resistor across the far end of the feedline. Let's say a 250Ω resistor was available, creating an SWR of about 5:1 when installed as indicated. Back in the shack you measure an SWR of 3.1:1 at a frequency of 3.99 MHz. Had the line been perfect (none are) you would have seen an SWR of 5:1. Had you done this test when the line was new you could have expected an SWR reading of 4:1. Reading from curve C of Figure 3 you find that under the described conditions the matched-line loss must be slightly greater than 1 dB, or approximately 0.7 dB per 100 feet worse than it was when the coax was new. Again, the coax is showing signs of aging but it will still work in this application. A similar increase in feedline losses to an EME array, on the other hand, would be a more serious problem.

Figure 3 will probably be adequate for most readers, but for those of you who may wish to do some experimenting, here are the general formulas for calculating the expected input SWR given the matched line loss and the SWR present at the load. It is a simple matter to incorporate these formulas into a BASIC computer program and arrive at answers tailored to your particular set of circumstances:

```
A = 10^(L/10)
B = (SWRL - 1)/(SWRL + 1)
SWRI = (A + B)/(A - B)
```

where L is the matched-line loss, SWRL is the SWR at the load and SWRI is the SWR at the input. More information on this topic can be found in the 15th edition of the *ARRL Antenna Book*.

Number 22 on your Feedback card

CIRCUITS

Great Ideas From Our Readers

Have a quick'n'easy circuit idea? Share it and get a one year subscription or extension to *73*! Clearly mark all entries as submissions for Circuits to distinguish them from manuscripts. Send your entries to Circuits, *73 Magazine*, Peterborough, NH 03458.

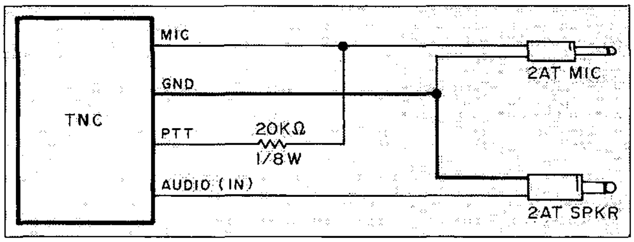

Figure 1.

Coupling Audio and PTT DC Circuits

The August 1987 issue of 73 contains an article by WB5WSV describing a way to interface the IC-2AT with the MFJ-1270 TNC-2 Terminal Node Controller. Normally, a microphone jack in a transceiver provides 3-wire operation of PTT and microphone audio where the circuits are kept separate. In the ICOM IC-2AT, however, the circuits are combined and operated through a 2-wire mike input jack (center pin and ground). The circuit described in the 73 article exactly duplicates the microphone circuit. The relay does the PTT switch closure, and the 50k potentiometer replaces the microphone element resistance. However, the circuit is too complex, relay-closure time delay is introduced, and the cost of the relay is an unnecessary expense. Also, there is the problem of providing +12V DC to operate the relay.

For the last 15 months, I have been interfacing an MFJ-1270 with an IC-2AT by using a simple one-resistor circuit. I do not use the loudspeaker circuit.

The reduced schematic, which is supplied in the 2AT User's Manual, *shows the PTT circuit as DC-coupled to the jack, and the microphone input as AC-coupled. Figure 1 in WB5WSV's article shows the circuit of the hand-held 2AT microphone. Notice that the microphone element and PTT switch are in series; closing the PTT switch provides a DC path through the microphone element. In voice operation, the audio signal current is superimposed on the DC PTT current. When interconnecting to the TNC, the necessary DC path is not provided through the audio (out) terminal; relay closure in the audio path does not make PTT current flow. R1 (50k pot) is connected in parallel, from the audio (out) terminal to ground, to provide the DC path. WB5WSV suggests 30k of parallel resistance for the DC path. I have used 20k and have had excellent results.*

Instead of having the series path for PTT and audio current run as shown in the hand-held microphone, combine the circuits in parallel. (See Figure 1.) The TNC provides a ground path via the PTT terminal through the 20k parallel resistor, and this resistor energizes the 2AT PTT circuit. Because the MIC audio is AC coupled, there is no interference with PTT operation. The audio generated in the TNC for transmission by the 2AT sees a parallel load of 2000Ω (audio circuit in the 2AT), 20k (parallel resistor), and 47k (PTT circuit in the 2AT) with equivalent resistance of 1750Ω. The TNC provides sufficient audio drive to handle this load.

Connect receive audio in the normal manner. I would suggest a level control if you want to monitor the buzz. After an evening of packet QSOs, you will probably want to turn off the sound and monitor with the blinking yellow light.

Ian Kushner AF6K
San Jose CA

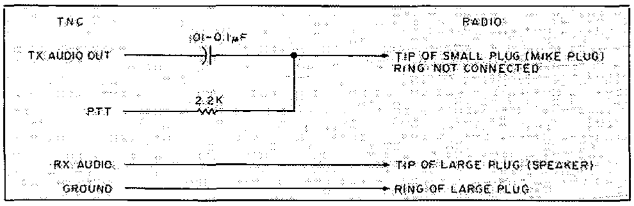

Figure 2.

FT-727R/Data Controller Hook-up

I recently bought an MFJ-1278 controller to use with my Yaesu FT-727R HT. The MFJ-1278 manual gives a method for connecting an IC-02AT using a small (1:1) audio transformer, where the TNC RX audio and HT speaker are connected directly to each other.

While this technique should work, it presents a problem from a convenience standpoint, since you need a separate box or enclosure for the audio transformer and leads.

I called Yaesu tech support at (213) 404-4884 and got the following alternate hookup info for the FT-727R which avoids the use of a transformer. This should work for most other Yaesu HTs, and for many ICOM HTs which use a similar mike/PTT setup. (See Figure 2.)

The cap can be anything in the range of 0.01–0.1µF. The resistor should be ½–¼ watt.

The cap and resistor can be wired up, then covered with heat sink material for a neat appearance. I've tried this on my setup and it works great!

Dale Gaudier N4REE
Atlanta GA

Packet/Voice Switch Box

Have you joined the Packeteers? If you don't have a 2 meter transceiver dedicated to packet, would you still like to avoid the inconvenience of disconnecting the input to the TNC and reconnecting the microphone before you can use the transceiver for voice?

A simple switch box lets you enjoy the benefits of both packet and voice communications without the need to change connections. Figure 3 is a wiring diagram of the switch box. The connector for the microphone needs to be the same as on the 2 meter transceiver. I was able to find a cable with a plug on one end that matched the microphone connector on my 2 meter transceiver. The connector for the cable to the 2 meter transceiver can be any suitable connector such as a DIN type. I used a D sub male connector (Radio Shack 276-1537) for the output to the TNC. The switch is a 3-pole 2 position, either a rotary or push-push type. The audio input on this transceiver is from the external speaker plug. I used a phono jack (Radio Shack 274-346) for this.

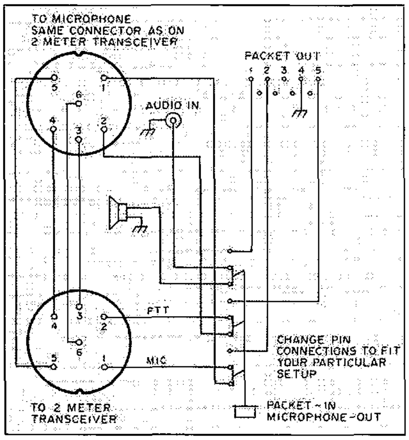

Figure 3.

I built my switch box with a flange on one side and mounted it on the side of the TNC with one of the screws holding the cover on the TNC. The box doesn't shift or move when I change positions of the switch.

Most of the newer high frequency transceivers have an output on the rear for PTT, AFSK, and Audio, but this box is useful for HF transceivers that don't have such an output and with which you have to use the microphone connector for the input to the TNC.

No more inconvenient connection changes!

Robert L. Dingle KA4LAU
Dayton Ohio

Number 23 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D. WA3AJR
6 Jenny Lane
Baltimore MD 21208

One-Chip AFSK Generator

You all are certainly a vocal crew. It may take me until Labor Day to sift through all the responses to the First Annual Decade survey published here. But, try I must, and I promise to let you all know the sense of the readership. . . just as soon as I figure out what it is!

In the meantime, here is the second in the series of one-evening kitchen table projects that you are all asking for. This month, I have a one-chip AFSK generator. With its reasonable purity of emission, it should be useful for putting many of you onto RTTY.

It's based on a versatile chip billed as a "function generator." I picked up my last few on the bargain clearance table at my local Radio Shack. While the XR-2206 may not be in the latest Radio Shack catalog, it certainly remains available from them on order, or on the Jim Paks wall of many distributors, for about six bucks, list price.

Figure 1 shows the schematic of the AFSK generator, which is easily assembled on a perf board just by following the diagram. Take special note of the chip's +Vcc—it is +10 volts DC, rather than the +5 volts DC common to other TTL chips.

The RTTY keying input is basically TTL level voltage, with a swing from less than one volt to more than two volts for the mark/space transition. Most keying circuits should supply this level without much trouble. If you would like to key this circuit off of a 60 mA teleprinter loop, you will need some form of isolation, such as an optoisolator or reed relay.

Meanwhile, the output frequency of this device is as stable as the frequency determining components used, particularly the capacitor connected between pins 5 and 6. Nominally a 0.01 µF capacitor, this should be a high quality, stable capacitor, rather than the common disc variety. The latter has too wide a manufacturing tolerance, and too much drift in value, to be used in this critical area.

A high level signal on pin 9 generates an output frequency determined by the combination of the capacitor between pins 5 and 6, and the resistor going to ground from pin 7. A low level signal on pin 9 similarly generates a signal dependent on the resistance of the potentiometer on pin 8. The formula is:

$$\text{freq} = \frac{1}{R \times C}$$

where *freq* is the output frequency, *R* is the resistance presented to either pin 7 or 8 to ground in ohms, and *C* is the capacitance in farads between pins 5 and 6.

With a 0.01 µF (0.00000001 F) capacitor and a 45kΩ (45000 Ω) resistor, a frequency of about 2222 Hz would be generated. This is well within the common AFSK range. Therefore, the use of a 50k potentiometer allows frequencies as low as 2000 Hz to be generated, with no real upper limit. If you like, for finer control, a 30k resistor in series with a 20k potentiometer would allow coverage of the 2000 Hz to 3000 Hz range, with much better accuracy.

The perceptive among you may have noticed that I have not really labeled one or the other signals "mark" or "space." That is because such labels are, after all, relative. If you are keying this circuit with a positive voltage for mark, and a zero or negative voltage for space, then the mark frequency will be determined by the resistor on pin 7, and the space frequency on pin 8.

However, if you are using a computer to key this circuit, and you are using the common RS-232 standard interface, then you may have a surprise coming. Mark voltage in the RS-232 standard is a negative voltage; space is positive. This is just the reverse of what we were talking about. But, no problem. Just use the potentiometer on pin 8 to set up the mark frequency, and pin 7 for the space.

You could put in a reversing switch if it were important to you to swap mark and space frequencies.

Now, for those of you who are VHF bound, the standard mark frequency is 2125 Hz. There are two standard shifts in use, the old 850 Hz, so-called "wide shift," and the newer 170 Hz, or "narrow shift." To save you trouble with higher math, that yields a space frequency of 2975 Hz (2125 + 850) for wide shift, and 2290 Hz (2125 + 170) for narrow shift.

VHF and SSB

But these are for VHF AFSK, you see. If you will be feeding this AFSK into a single sideband transmitter to produce FSK, you don't need those frequencies at all. Most transmitters will not pass a signal upwards of 2000 Hz that well, as the audio stage is peaked for voice transmissions. Therefore, feel free to use a lower set of frequencies. There are two precautions you should take, though.

First, choose a pair of frequencies, not harmonically related, that fits in the passband of your transmitter. If you are using wide shift, for example, *don't* choose 850 Hz and 1700 Hz. I know that they are 850 Hz apart, and reasonably low, but the higher is the first harmonic of the lower. Bad news! Better to choose 1000 Hz and 1850 Hz, or a similar combination for a 170 Hz shift.

Second, remember that FSK convention places the space on the lower frequency. That is, the frequency shifts downward from the mark frequency. When transmitting on lower sideband, the audio tone used for space is the higher frequency, reversed from FSK convention. This goes along with AFSK practice, though, so there is some consistency. Once again, generate an AFSK pair with a low mark and high space, and use lower sideband to convert this into an FSK signal with high mark and low space.

Transmitting

Now that you've selected your transmit frequencies, you will want to couple the signal to your transmitter. The potentiometer on pin 3 controls the amplitude of the output signal. According to the specs of the chip, about 60 mV of signal are available per kilohm of resistance, so a 50k resistance should generate about 3 volts peak to peak.

The adventurous among you might chose to combine the previous demodulator project and this month's modulator into a box, with a common power supply, and make a small RTTY modem. Keep all that data flowing this way, to the above address, or electronically. Either CompuServe (ppn 75036,2501) or Delphi (username: MARCWA3AJR) are fine. Let's hear from you!

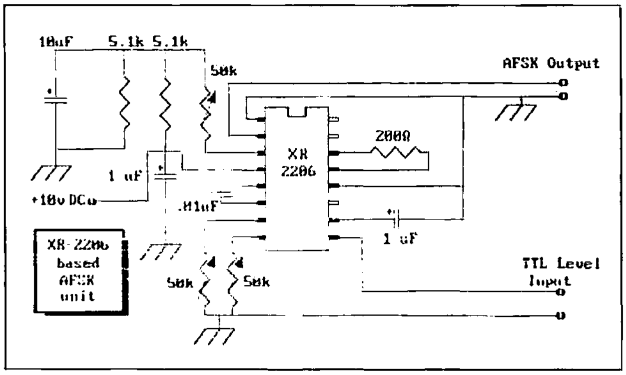

Figure 1. Simple one-chip AFSK generator.

AFSK Generator Parts List

Integrated Circuit	XR-2206	Jim-Paks or mail order	
Resistors	5100Ω	RS 271-13305*	$0.39
(¼ or ½ W)	220Ω	RS 271-13135	$0.39
Potentiometer	50000Ω	RS 271-219	$0.69
	Miniature PC mount		
Capacitors	0.01 µF	RS 272-10652	$0.59
	1.0 µF	RS 272-1434	$0.59
	10.0 µF	RS 272-1436	$0.79
Perf board	0.1 inch grid	RS 276-1394	$1.99

*Radio Shack parts are nearest whole values. Resistor values are nominally within 10%. For all practical purposes, the available Radio Shack values are close enough for this project to the specified values. If you can get exact values, fine. If not, don't lose any sleep over it.

HOMING IN

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S-Meters

How well does your two meter FM transmitter hunting setup work when the signal is really weak? Getting an accurate bearing with a beam or quad is tricky when the signal just barely breaks the squelch. Such situations are common at the beginning of hunts, particularly after you leave the high elevation of the starting point.

Today's VHF and UHF rigs are very sensitive, but their S-meters are not. The S-meter takeoff point must be at an early stage in the IF chain to minimize saturation effects and give maximum dynamic range (which is none too high anyway). So the typical S-meter doesn't start upscale until the signal is about 10 dB above the threshold of detection.

There have been a lot of hunts where I've gone well over halfway to the hidden T before getting S-meter readings good enough to use for bearings. Without meter indications, the only way most hunters can get a bearing is to find the squelch break points and average between them. This method is often inaccurate due to flutter and local noise conditions.

The better equipped you are to get bearings on weak carriers, the better your chance of winning the hunt. Wouldn't it be great if there were a way to indicate the strength of signals that are too puny to move typical S-meters? There is!

Squelch Secrets

Ever notice that the squelch on your VHF-FM rig opens properly on stations that are too weak to read on the S-meter? That's because the squelch senses the signal level in the IF differently from the way that the S-meter does this. If the squelch worked like the S-meter, it would be very insensitive and unreliable. Instead, the squelch uses the "quieting" effect that occurs on even the weakest FM or CW signals.

Because of the very high gain of the IF stages in an FM receiver, the FM detector stage (the discriminator) outputs a high level of random noise when it's not receiving a signal, sometimes as great or greater than the peak audio level of typical signals. Most of the noise is at high audio frequencies, well above the passband of the speaker amplifier. When any carrier-type signal (such as FM) comes in, even if it is very weak, this noise is quieted. The stronger the signal, the greater the quieting.

Figure 1 shows the output stages of a typical FM receiver. Signal pickup for the squelch comes directly from the discriminator and passes through an audio high-pass filter. The system senses the supersonic noise components instead of the voice range audio, then amplifies and rectifies the noise. Next, a logic circuit decides if there is enough quieting to represent a signal. if so, the squelch gate connects the discriminator audio through a low-pass filter (the de-emphasis network) to the speaker amplifier. In many radios, the squelch control varies the gain of the noise amplifier, as in Figure 1. In other sets, such as the Kenwood TR-7950, the squelch pot is part of the logic.

WA6DLQ's Noise Meter

Why not meter the squelch detector? Great idea! The rectified noise is a very sensitive indicator of the relative strength of feeble signals.

There are two methods for metering noise on ham VHF-FM transceivers. The easiest way is to find a takeoff point in the receiver where there is a DC voltage proportional to the noise, then amplify that voltage to drive a meter. That's what Vince Stagnaro WA6DLQ did with his TR-7950 two meter rig. It's practical for other rigs, too.

WA6DLQ's meter box features a switch, S2 (see Figure 2) to make the unit either a noise meter or an external S-meter that tracks the one in the TR-7950. With this system, you hunt weak signals using the noise meter then, when the signal gets to near full quieting, switch to the S-meter position and use your dashboard meter instead of the small one on the transceiver.

The collector of transistor Q12 in the TR-7950 is an ideal noise meter pickoff point. With no signal, rectified noise turns Q12 on hard, resulting in Q12 collector voltage near zero. As the signal level rises toward full quieting, the drive to Q12 decreases until it is at cutoff, and the collector voltage rises to about +7.3 volts. The S-meter tapoff for the TR-7950 comes from TP3, which varies from 0 volts with no signal to +1.6 volts at full scale.

The meter amplifier unit is basically a straightforward DC gain stage using the National LM324 quad op amp, U2. (See Figure 2.) This chip is ideal because it works when input voltage is near zero, with no need for a negative supply voltage. Be sure to strap and ground the unused sections, as shown.

Easy-To-Find Parts

Most parts for this project are carried at Radio Shack. L1–L2 and C1–C4 are filters to keep RF out of the radio and meter circuitry, and can be omitted if there

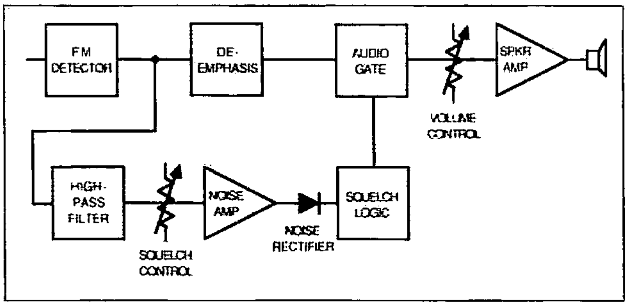

Figure 1. Block diagram of a portion of a typical VHF-FM receiver, showing the discriminator, audio, and squelch.

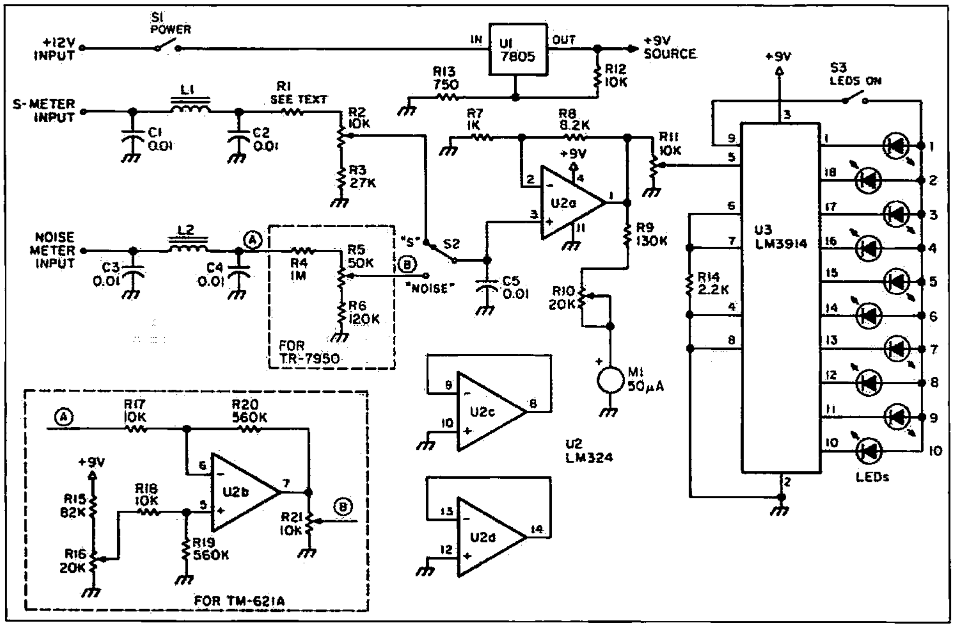

Figure 2. Schematic diagram of WA6DLO's noise meter and external S-meter circuit for use with the Kenwood TR-7950 and TM-621A transceivers.

Continued on page 80

Number 25 on your Feedback card

HAMSATS

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
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HAMSATS AWAY FROM HOME

Satellite mobile operations do well with low-orbit, amateur radio satellites like RS-10/11 and Fuji-OSCAR-12. The October and November 1987 columns discussed mobile activity in detail. But what about portable setups?

With gain antennas, the high-orbit birds, like AMSAT-OSCAR-10 and 13, can yield many enjoyable contacts while you're on vacation or at a weekend campout at the beach. Today many radios operate from 12 volts DC, and gain antennas don't need rotators; pointing adjustments are made only every 20 to 40 minutes during a typical satellite pass.

Many VHF and UHF satellite-chasing antennas can be broken down into easily transportable pieces. If installed at a remote location, a pole just tall enough to keep the antennas above ground and aimed at the sky provides a sufficient mast. To rotate your antenna by hand, lash it to a six-foot stepladder for easy access.

Equipment Choices

Your antennas for A-O-13 Mode B (70 cm up and 2 meters down) should be the best you can take along. For most stations the Cushcraft AOP-1 package will suffice. Both the 20-element, 2 meter crossed yagi, and the 16-element, 70 cm antenna should be set for right-hand circular polarization (RHCP). The 70 cm, crossed yagi construction project, featured in the May 1989 special satellite issue, would also do well. Keith WB5ZDP has been able to put these antennas together in only a few hours.

Other antennas, like those shown in the photos from N6JJI, may draw both curious looks and great results. Alex uses a corner reflector fed with full-wave loops for 2 meters and 70 cm. The reflector is made from two sheets of aluminum diamond screen 48 inches by 20.5 inches, supported by a wooden frame. It uses PVC plumbing with a bearing to accommodate any polarization.

The 70 cm loop is tuned to 435.5 MHz, and spaced 8.75 inches from the 90-degree corner; the 2 meter loop is spaced 18.25 inches from the corner. The assembly is placed on a surveyor's tripod and aimed manually at the satellite. Preamps for 2 meters and 70 cm are located at the loop feedpoints. Alex reports excellent contacts with Europeans while operating from his Long Beach, California, QTH.

Field Day Operations

During Field Day this year, our group in south Texas was active via Mode L (23 cm up and 70 cm down). We used an ICOM 1271A all-mode 1.2 GHz transceiver with a Down East Microwave 35 watt, solid state amplifier for the uplink. The antenna was a four-foot dish with the coffee-can feed system shown in *The ARRL Handbook.* The system, rotated by hand, was propped in place with a four-foot pipe in the ground and steadied by elastic cords. The winds occasionally get brisk on the beach at Galveston, so a few stakes and some rope helped. If you are considering a portable Mode-L station, check WB5ZDP's dish article in the May issue of *73.* This five-foot parabolic reflector provides excellent gain for good contacts with only 10 watts of 1.2 GHz energy.

Our Field Day Mode L downlink system incorporated a Cushcraft 416T mounted near the dish. An Advanced Receiver Research GaAsFET preamp in front of a Yaesu FT780R mobile all-mode 70 cm transceiver completed the operating position. All of the radios ran from a group of batteries charged by solar panels.

On your next portable outing you can discover the satisfaction of real VHF/UHF DX via satellite. With terrestrial line-of-sight operation, you have to climb a mountain just to get marginal copy from a nearby county or state. Give portable satellite activity a try!

New Publications

AMSAT North America has announced a new magazine and a completely updated beginner's guide with comprehensive details on A-O-13 operation from the ground up.

The new quarterly magazine, the *AMSAT-NA Journal,* has Joe Kasser G3ZCZ/W3 at the helm. Joe was editor of the popular magazine *Orbit* in the early 80s, and in charge of the *AMSAT Newsletter* during the late 70s. The new publication is available only to AMSAT members. They will continue between issues of the new journal, with timely amateur-satellite news items and orbit data. If you would like to join, dues are $30 per year. Write *AMSAT, PO Box 27, Washington DC 20044,* or call the main office at (301) 589-6062.

Keith Berglund WB5ZDP recently compiled a new Beginner's Guide to A-O-13 operation via Modes B and J. Keith WB5ZDP compiled this fifty-page manual. The cost is $7. For new members, it is $3, just enough to cover printing and postage.

The guide contains comparison charts for commercial satellite antennas, 2 meter and 70 cm multimode rigs, receive converters, and preamps. Also included are discussions and explanations of computer tracking programs and printouts, instructions for the proper use of N connectors, data on coaxial cable attenuation, diagrams of typical earth-station interconnections, and satellite transponder configurations and antennas. A complete uplink/downlink frequency chart of A-O-13 explains its orbital characteristics and gives the beacon telemetry output schedule. The text, full of computer graphics, was produced on a laser printer.

The *Amateur Satellite Report* will certainly be an excellent reference for all current and future satellite chasers. For the new enthusiast, it contains a list of AMSAT Area Coordinators with addresses and phone numbers to provide local contacts for individual help. Copies are available at AMSAT booths during most ham conventions and directly from the AMSAT office. Get a copy. You'll be glad you did. 73

Photo A. N6JJI's corner reflector with full-wave loops for 2 meter and 70 cm. Built with a wood frame and mounted on a surveyor's transit, this simple satellite antenna has logged many DX contacts via A-O-13.

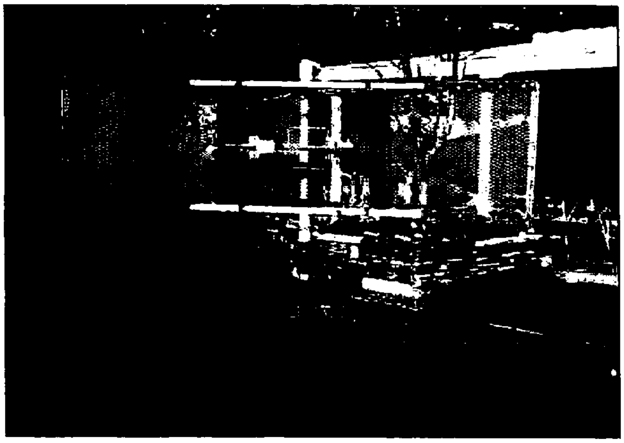

Photo B. Front view of N6JJI's corner reflector antenna. The antenna is tiltable for any polarization.

Number 26 on your Feedback card

ASK KABOOM

The Tech Answer Man

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"Schematic" Defined

Most folks I've met who claim to be diagram-literate point with pride to various components, thinking that the ability to recognize them constitutes "reading" the schematic. That's like saying that recognizing the letters of the alphabet is the same as reading a novel!

The root of the word "schematic" is "scheme," and that is the diagram's purpose: to impart the scheme, or path of signal flow, of the circuit.

Think of the components as the characters, the overall function (such as "transmitter") as the theme, and the signal flow through individual circuit stages as the plot winding its way through the various chapters. Like a book, a given circuit and its diagram can involve many subplots and themes before arriving at its conclusion, typically the antenna or speaker of your radio.

Good vs. Evil

Also, like a book, there are good and bad circuits, and good and bad diagrams. Generally, late-model Japanese gear comes with good diagrams. Older stuff can be questionable. A truly great diagram will show voltages, and sometimes even oscilloscope waveforms for the inputs and outputs of each stage. It may also illustrate signal flow with emphasized or color-coded lines. Having this information makes troubleshooting a breeze, because you know what should be happening when the thing works. The service manuals for most VCRs have this kind of data, but it seems to be coming into use only recently for ham gear.

A normal "good" diagram will at least be logically laid out, with circuit stages arranged so that most signal flow occurs from left to right, and with clearly marked terminals, transistors, and ICs. (Some use actual part numbers, such as "2N2222A," while others may use a "callout" such as "Q11," referring you to a separate parts list. Part numbers complicate things less.) If you know how to read it, it should quickly give you a sense of how the circuit is meant to work, hopefully triggering ideas regarding where to look for trouble.

A really rotten schematic may have sparse, or even no, component markings. It may be illegible, show layout of stages in a jumbled manner, omit parts, or even have errors. Fortunately, erroneous schematics are very much the exception.

Learning to Read

Ok, you've got a repair job, and the schematic looks decent. Where to begin? In past columns, I've mentioned the idea that electronic circuits are made up of bite-sized stages. If, for example, you examine the diagrams for various receivers, you'll see that, while the actual circuitry can differ greatly, the basic scheme is the same. There's an input stage to couple the signals from the antenna, perhaps an RF amp, one or more local oscillators, some IF stages (easily identified by the transformers between each one), a detector, and an audio amp.

Generally, at the center of each stage is an active device. Active devices are those which require power input from the power supply, and modulate that power to achieve switching, amplification, or oscillation. They define the stage's purpose, and are often the cause of its failure. These devices include tubes, transistors, ICs (linear and digital), SCRs, and most other semiconductors.

Passive devices, such as resistors, capacitors, and coils, can be thought of as support systems for the active devices. The passives are the lungs and kidneys providing the active brains with what they require to function, and most active devices are surrounded by them.

Focus on the active device at the center of each stage, and the organization of the stages should become clear. To do this, you MUST have at least some idea how the active device works. If you don't know that current between the base and emitter of a transistor makes the collector-emitter path conduct, then you can't hope to understand the stage's function. There are many good books covering the common active devices, and I hope to explore semiconductors in more detail in future columns. Let me emphasize that you don't have to be an engineer, or need to understand complex formulas, in order to master this. If you comprehend Ohm's law, and have some basic knowledge of the active devices, you can learn to see the signal flow through nearly any circuit.

Identity Crisis

Probably the biggest hurdle for beginners is the identification of stages. Which one is the power supply and which one is the audio amp? As a rule, look for a part you know, and see where it's connected. For example, once you find the speaker, you can't help but find the audio amp! Here's a guide to identifying common stages:

AC Power Supplies nearly always have a transformer with the primary winding typically shown to the left, and one or more secondaries to the right. Hanging off the secondaries will be rectifiers (diodes) followed by big capacitors. The capacitors will be marked for polarity (+ or −, usually + on the diagram, and − on the part itself). Sometimes, coils, transistors, and even ICs may be included. But the transformer is a dead giveaway.

Audio Amps can be made of transistors or on a chip. Look for the speaker and earphone jack. Discrete (non-chip) amps are usually push-pull, which means they feed the speaker with two transistors working together, one for each half-cycle of the audio waveform. The transistors are usually shown one above the other, with either the speaker or a capacitor leading to it, connected where the transistors meet. Once you've successfully recognized this type of stage, it'll stand out in your mind any time you see it again.

RF "Front Ends" are the input stages coupling the antenna to the first mixer. They may be passive or may contain an RF amp. Look for the antenna. In a transceiver, it may be coupled to both the transmitter's output stage and the front end at the same time. If the feed to the first active device is to its base or gate, then you've found the receiver. If it's to an emitter or collector, that's most likely the transmitter final. There are some front ends using what is known as a "common base" amplifier, in which the base is grounded and the emitter or collector serves as the input, but it isn't common.

Oscillator failure is a common cause of dead receivers and transmitters. In a transceiver, failure of both together warrants a look at the oscillators. Look for crystals, variable capacitors, and coils. Generally, fixed-frequency and manually-tuned oscillators have connections for power, ground, and output, with no other inputs. Variable oscillators used in synthesizers have an input to control the frequency with a voltage. In these, look for varactor diodes, which look like a combination diode and capacitor on the diagram.

Mixers and Product Detectors mix the incoming signal with an oscillator to heterodyne to a new frequency, or for audio detection. They can be active or passive. Passive ones look like the bridge rectifiers (four diodes in a diamond configuration) in power supplies. Active ones can be made from transistors or chips. Look for two inputs, one from the preceding signal stage, and one from an oscillator.

IF (Intermediate Frequency) Amps amplify and filter the heterodyned signals resulting from the action of the mixer. They always have tuned circuits between them, usually using transformers, and there will be several in a row. In receivers, they are followed by detectors. In transmitters, you can follow them by driver amplifiers leading to the RF final. Either way, the succession of stages with their transformers (or sometimes ceramic resonators, which are drawn somewhat like crystals) between them, makes them easy to spot.

RF Final Amps build up the power and pump it to the antenna. In CW and FM rigs, they can be very simple, consisting of little more than a transistor with input and output transformers. In SSB rigs, they are somewhat more complicated, and can look similar to push-pull audio amps, except that they have transformers at their outputs. In any event, their signals will lead to a coil/capacitor filter and then to the antenna or antenna relay.

Digital Controls are made up mostly of chips, which are drawn as boxes with lots of leads. They have many interconnections, and can be quite hard to follow. Usually, your focus will be on their outputs to the rest of the radio. The rows of chips are unmistakable.

Next month—more letters. Til then, grab some schematics and start reading!

Number 27 on your Feedback card

LOOKING WEST

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Notable Ham-Com Event

At last!—the FCC released the newly reorganized Part 97 Amateur Service Rules on Saturday, June 3, at the ARRL Diamond Jubilee National Convention in Arlington, Texas. Robert McNamara, Chief of the Special Services Division, and John B. Johnston W3BE, Chief of the Personal Radio Branch, brought the regulatory revision to the Arlington convention, and presented them before a standing room only crowd.

Part 97 Past

Prior to this action, Part 97 had not undergone a major restructuring since 1951 when most communications systems in the Service were using HF hand-keyed telegraphy and AM telephony. Since then, a number of emerging technologies, such as SSB, FM telephony, VHF and UHF repeaters, radio-teleprinting, satellite transponders, digital communications, television, and other modes have become popular. And, while rules have been modified or added to accommodate these technologies, the result has been a patchwork quilt of rules surrounding an antiquated and often confusing structure.

The New Part 97

In a prepared press release, the Commission recognized that current amateur radio rules don't easily apply to modern amateur radio communications, such as packet radio. Thus, the FCC reorganized Part 97 of its rules to create a regulatory environment designed to encourage modern techniques and modern technology in the Amateur Radio Service. They also made the rules easier to understand, and deleted any unnecessary, obsolete, and redundant provisions.

The essential tenets for the Service, however, remain the same. "The Amateur Radio Services consist of the Amateur, Amateur Satellite, and Radio Amateur Civil Emergency Service (RACES)" noted the FCC, continuing: "The amateur service exists for the purpose of self training, intercommunication, and technical investigation carried out by duly authorized persons interested in amateur radio techniques solely for their personal purpose and without any pecuniary interest."

Part 97 has now been restructured into a format of six subparts and two appendices. These are:

•Subpart A: General Provisions, which contains those rules concerned with license and station location requirements.

•Subpart B: Station Operating Standards, which comprises those standards that apply to all types of amateur station operation.

•Subpart C: Special Operations, which contains the requirements that apply to non-standard operations such as repeaters, beacons, and the Amateur Satellite Service.

•Subpart D: Technical Standards for all operations.

•Subpart E: Emergency Communications, which contains all rules applicable to operating in distress and disaster situations along with the rules governing RACES.

•Subpart F: Qualifying Examination Systems, which is self-explanatory.

•Appendix I lists the geographic area of the world where the FCC holds jurisdiction of the amateur service.

•Appendix II lists Volunteer Examiner Coordinator regions.

More Liberal

The new rules combine those regulations that pertain to an amateur station providing emergency communications with those that govern RACES stations. They do not, however, change the basic principles or purpose of the Amateur Service in the United States. Also unchanged is the "Quiet Hours Rule" that can be used to impose restrictions as necessary on the operation of amateur service stations to eliminate interference to home entertainment equipment. The proposed change to delegate blanket authority to impose quiet hours was a major source of irritation to the amateur community, which feared that FCC engineers might abuse such a power. In the final version of the revised Part 97, the authority to impose Quiet Hours will remain as it has been.

The general prohibitions against amateur stations transmitting communications as an alternative to other authorized radio services, such as commercial radio services, has been clarified. They now allow any required emergency communications. The new rules also permit the use of amateur radio stations to provide communications that relate to the public's safe observation and participation in parades, marathons, and similar public events so long as the principal beneficiary of the communications is the public, and any benefit to the event sponsor is incidental.

Communications relating to the buying and selling of amateur station apparatus—such as ham-radio swap-nets—will also be permitted as an exception to the prohibition against business communications. However, the new rules expressly forbid any communications by persons seeking to profit from such sales or purchases on a regular basis, e.g. on-the-air dealers.

Another exception in this area is business communications that assists journalists in filing stories. Such reports, however, must not detract from the efforts of other stations that are actually engaged in providing emergency communications. Just about every mass media outlet in the nation, including ABC, NBC, CBS, and CNN, lobbied hard for this exemption.

With respect to operator license examinations, the FCC codified the policy that a telegraphy receiving test alone is adequate proof of both sending and receiving ability. The exam test message must be sent for at least five minutes and contain all letters, numbers, and prosigns. Also specified is the exact number of questions that must be answered correctly for each exam element to replace the previous method dealing with percentage of correct answers. The new rules also give administering Volunteer Examiners the authority to require expert verification that an examinee with a physical disability requires a reader or transcriber other then the one administering the exam element. In another rule change, the concept of the Regional VEC was deleted and all VECs are now National and permitted to service tests wherever they desire.

The new rules retain the "definitions" sections, and some terms used in the Amateur Service Rules have been shortened and/or simplified. By way of example, the terms "beacon," "repeater," "earth station," and "space station" are now defined. The Commission also included an exception to the prohibition on international third party communications that states the prohibition does not apply to any third party who is eligible to be control operator of the station.

An exception to the time limitation for a RACES Drill has been incorporated where an Emergency Planning Official has approved the drill or test. Also, the "Good Amateur Practice" requirement has been combined with the rules governing frequency selection, frequency sharing, and malicious interference. Also under the new rules, a representative of a foreign government is not barred from holding a reciprocal permit.

With respect to repeaters and allied relay operations, the revised rules delete the antiquated requirement that relay operations be discontinued within five seconds after cessation of the relayed radio communication by the user stations. The restriction that a repeater cannot transmit on more then one channel from the same location was also deleted.

In addition, the FCC also clarified the permissible emission types to be used by amateur stations, and codified or clarified many other policies concerning amateurs that have evolved over the years as interpretations of existing rules. Also codified is the existing FCC policy concerning state and local regulations governing the height and placement of amateur station antenna structures. The new Part 97 also includes the essential holding of the Commission's PRB-1 limited preemption ruling that local regulation of an amateur service antenna structure must not preclude amateur service communications.

The Future

The new Part 97 is definitely a step forward in modernization of the United States Amateur Service. Thanks to the work of Personal Radio Branch Chief John B. Johnston W3BE and his staff, our service has a new lease on life—one to carry it forth into the 21st century and maybe, hopefully, beyond. 73

(Adapted from *FCC News Release*—May 30 1989 with special thanks to Joe Schroeder W9JUV and Fred Maia W5YI.)

Number 28 on your Feedback card

NEW PRODUCTS

Compiled by Linda Reneau

PRODUCT OF THE MONTH

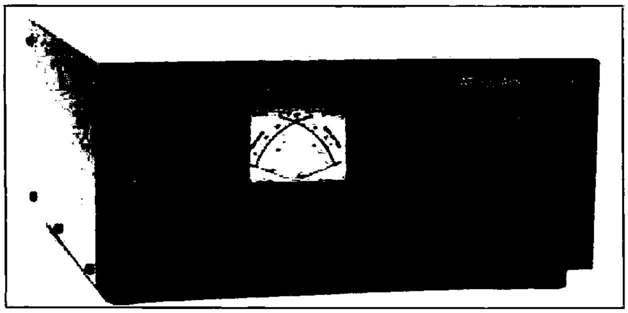
AZIMUTH COMMUNICATIONS CORPORATION
THE AZIMUTH AWARDS QSL LIBRARY

Azimuth announces its Awards QSL Library albums for organizing and protecting your QSL cards. You can select an album for each kind of award—DX Century Club, Worked All Zones, Worked All States, and Worked All Continents, with beautiful graphics for each award. Or you can order an album for all your QSLs in general.

Each album is made of durable, quality vinyl, its 20 scratch-resistant pages holding 120 cards. Each pocket-page holds six 4 x 6 cards.

The introductory price is $20; extra 20-page packs are $13. Add $2.50 for shipping and handling per album and page pack (foreign orders, add $7.50 US). California residents please add sales tax.

If you order now, Azimuth will send you FREE their AWARDS-BASE Log & Tracking Program for IBM-PCs and clones. Retail, this program costs $25. For VISA and MC orders, call *(800) 882-7388*, or write *Azimuth Awards OSL Library, Dept. E73, 11845 W. Olympic Bl., Suite 1100, Los Angeles CA 90064.* Or circle Reader Service Number 201.

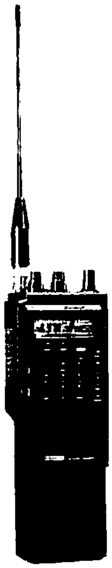


ADVANCED ELECTRONICS APPLICATIONS, INC.

Advanced Electronics has a new antenna tuner. The AT-300 features a low-pass design to reduce or eliminate TVI; coverage of 3.5–30 MHz; 300 watts continuous power; a dual-needle wattmeter; and two 18-tap inductors for tuning accuracy. The meter range selects 300 watts and 30 watts to ease tuning.

Front panel controls include impedance adjustment, and switching for power, antenna, and meter lamp.

Rear panel connections include a coax connector for input, two coax connectors to antennas, one coax connector to a dummy load, two ceramic feed-through connectors to balanced feedlines, one for single-wire antennas, and a DC power connector to the meter lamp. Price, $250. *Advanced Electronic Applications, Inc., PO Box C2160, Bldg. O & P, 2006-196th SW, Lynnwood WA 98036-0918. (206) 775-7373. Telex: 6972496 AEA INTL UW. FAX: (206) 775-2340.* Or circle Reader Service Number 202.



KENWOOD USA CORPORATION

Kenwood's new dual-band TH-75A has many of the features of the dual-band mobile transceiver, and uses the same accessories as the TH-25AT (except for the soft cases).

The dual watch function allows you to monitor both bands at the same time. For readibility, it has a large multi-function LCD display. Ten memory channels for each band store frequencies, CTCSS, repeater offset, step information, and selectable full duplex operation. Two memories are for odd split operation.

The CTCSS encode/decode is built-in, and the automatic band change switches between main and subband when a signal is present. The TH-75A also has auto offset selection on 2 meters, four-way scan, tone alert system, and battery-saver circuit.

Extended receiver range covers 140–163.995 and 438–449.995 MHz; transmit on amateur band only. The TH-75A is modifiable for MARS and CAP, with permits.

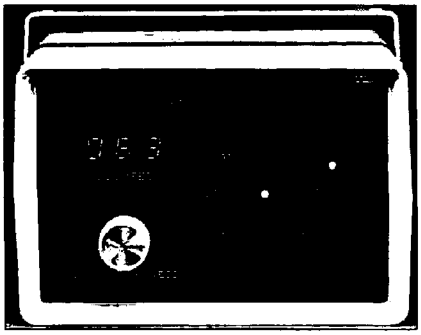
The TH-75A operates on 1.5 watts on 2 meters and 70 cm, and 5 watts when it operates on 12 volts DC (or PB-8 battery pack). A lithium battery backs up memories.

Suggested retail price, $550. Soft case optional. *Kenwood USA Corporation, Communications & Test Equipment Group, 2201 E. Donimguez Street, Long Beach CA 90810. (213) 639-4200.*

DOPPLER SYSTEMS, INC.

Doppler Systems has expanded its RDF systems to cover frequencies up to 1 GHz. The 5000 series, using a remote RF summing circuit, is accurate ±5 degrees. Doppler offers a wide range of antennas to cover frequencies between 108 and 1000 MHz.

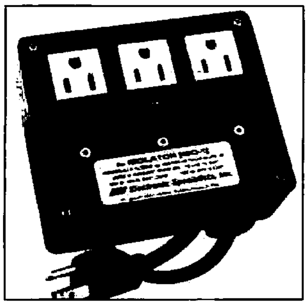
With a narrowband FM receiver, the system works in a quasi-Doppler mode. Using a patented technique, four antennas arranged in a square pattern simulate a single, rotating antenna. As it moves toward the RF source, the apparent frequency increases, and as it moves away, the apparent frequency decreases. A narrowband FM receiver detects this Doppler shift and sounds a 300 Hz tone. The RDF system measures the phase angle and displays the bearing. Quasi-Doppler mode is good for tracking unmodulated carriers and standard NBFM signals. In amplitude mode with an AM receiver, it's good for tracking aircraft band amplitude modulated signals, including ELTs.



A typical installation consists of a processor/display unit, an RF summer unit, and one or more antennas. A receiver is required. You may use a good quality scanner, but if you use transceivers, service monitors, or spectrum analyzers, take care not to transmit through the direction finder.

The price of an RDF Doppler System ranges from $955 to $1850, depending on the type of installation—mobile or fixed—and antenna requirements for your operating frequencies. *Doppler Systems, Inc., PO Box 31819, Phoenix AZ 85046.* Or circle Reader Service Number 206.

ELECTRONIC SPECIALISTS, INC.



Electronic Specialists has expanded their patented isolator line to include remote power switching, power fail interrupt, and 20 amp options. Suppressor performance of all units has been expanded to 39,000 Surge Amps for added equipment protection. Isolators, with wide band-high attenuation channel filters, are widely used in industrial and laboratory computer or sensitive equipment applications to provide smooth AC power conditioning.

Available in Commercial, Industrial, and Laboratory Grades. Prices start at $100. *Electronic Specialists, Inc., 171 South Main Street, Natick MA 01760. (800) 225-4876.* Or circle Reader Service Number 203.

THE RADIO WORKS

The CAROLINA WINDOM/2© is a half-size 40–10 meter version of the CAROLINA WINDOM© with performance equal to the latter. It covers seven HF bands, including all WARC bands. A transmatch is required on all bands. It is fed with 50Ω coax.

It has a 10-foot vertical radiator section which works with the 66-foot long horizontal radiator to produce complex radiation patterns. Simultaneously, the horizontal radiator acts as a counterpoise for the vertical radiator. Radiation takes place high in the air for high efficiency, since ground losses are avoided.

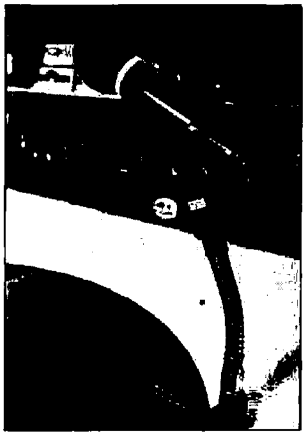
Each antenna comes assembled, complete with matching unit, vertical radiator section, highpower transmission Line Isolator©, #14 stranded antenna wire, glass-filled insulators, CoaxSeal® and illustrated manual. Price, $70. *The Radio Works, Box 6159, Portsmouth VA 23703. (804) 484–0140.* Or circle Reader Service Number 204.

ELENCO ELECTRONICS, INC.

The Elenco SG-9000 is a high frequency signal generator capable of AM modulation. It incorporates a stable RF oscillator with frequency range of 100 kHz to 150 MHz. It has an easy-to-read dial. Frequencies of 455 kHz, 4.5 MHz, and 10.7 MHz are specially noted for easy setting.

An internal audio frequency of 1 kHz is available for AM or external use. External crystals may be used to lock the oscillator to, say, a frequency between 1–15 MHz. The RF output voltage is variable and has a 20 dB attenuator switch. The SG-9000 comes with instruction manual with circuit description, block diagram, and schematic. Cost, $196. *Elenco Electronics, 150 W. Carpenter Avenue, Wheeling IL 60090. (312) 541–3800. FAX: (312) 520–0085. Telex: 706061 ELENCO UD.* Or circle Reader Service Number 207.

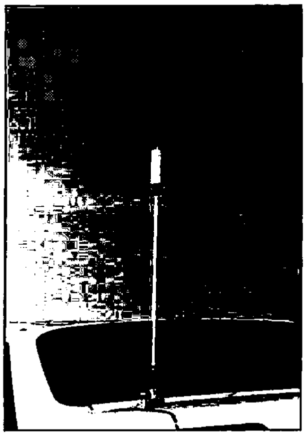
HEIL SOUND



The HM-10 microphone is at the center of Heil Sound's Concept 2000. Unlike other amateur radio microphones, the HM-10 uses professional cannon-type 3-pin connectors. You can buy the HM-10 by itself, or with the Heil HC-4 "DX Dream Machine" or the Heil HC-5 full range element.

Interface the HM-10 to your transmitter input connector by specifying the cable with the right color: red, Kenwood; yellow, Yaesu; blue, ICOM; and black, special. Operate PTT or vox, handheld or desk mounted. Adjustable booms and goose-neck mounts available.

The HM-10, built for durability, is heavy and rugged. Wired, with plugs, carrying case, stand adapter, colored cable, and foam windscreen, the price is $80. *Heil Sound, PO Box 26, Marissa IL 62257. (618) 295–3000. Contact: Bob Heil.* Or circle Reader Service Number 205.



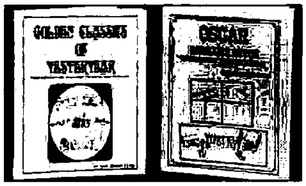
HUSTLER, INC.

Hustler announces a new HF mobile mast for their line of mobile resonators and accessories. Model MO-4, a 22" all-stainless steel mast, creates many mounting options previously unavailable to the mobile HF operator. It's ideally suited for RVs, trucks, vans, and cars with plastic bumpers. You can mount it on trunk lips, mirrors, roof racks, and ladders. In conjunction with standard Hustler resonators, you can install the MO-4 on a high quality magnetic mount.

You can make a shortened dipole with two MO-4 masts and a matching pair of resonators. You can assemble a tri-band dipole, good for apartments and areas of restricted space, by adding two Hustler VP-1 triband adapters and two resonators.

The MO-4 comes with three 30" tip rods for 10, 15, and 20 meter resonators. No tip rods are necessary on 40, 75, or 80 meters. Suggested retail price, $20. *Hustler, Inc., One Newtronics Place, Mineral Wells TX 76067. (817) 325–1386.* Or circle Reader Service Number 209.

MFJ ENTERPRISES, INC.



Dave Ingram K4TWJ shows you how to collect, restore, and operate classic ham gear in his book, *Golden Classics of Yesteryear,* published by MFJ Enterprises, Inc. Remember the 6L6 rigs, Heathkit DX-100, Collins KWM-1, WRL Globe Scout, Hallicrafters, RME, Hammulard, National HROs, Eimac tubes, Vibroplex, Speed-X, Dow KEY, McElroy. . .?

The book is packed with real-life tales and easy-to-build weekend projects from the 20s, 30s, and 50s. K4TWJ shows you how to build a "Tailender"—an early DX memory keyer that requires no power supply or electronic parts, but works "like a champ." He includes favorite circuits, telegraph keys and bugs, and other ham topics.

Dave has authored over 300 articles and 12 books. He writes the "World of Ideas" column in *CQ.* Order his latest book for $10 from *MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762. Telephone: (601) 323–5869 or (800) 647–1800. FAX: (601) 323–6551. Telex: 53 4590 MFJ STKV.* Or circle Reader Service Number 210.

QRP

Low Power Operation

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Portable Operation

Operating portable requires very little—one portable radio and a source of power to operate it from. I've always been inclined to operate portable with solar panels, but sometimes they're just too much trouble to set up. Likewise for conventional 110 volt power supplies. Ruins all the fun if you have to dig up a hundred-foot extension cord. Operating portable from the deck of the house just isn't the same as doing the same in a field or in the woods.

Because of the small current drain of most QRP rigs, battery power is quite attractive. A small Gel/Cell™ will operate my Argonaut for many a weekend. But what do you do when that battery needs charging? I just connect it up to the solar panels and let the home-brew control circuit do its thing. What's this? You don't have solar panels for battery recharging? Well, that's what we're going to build this month: a 110 volt battery charger, but with a twist—actually, a pulse or two. This unit will charge all kinds of batteries, from Gel/Cells to sealed lead-acid batteries, vented lead-acid batteries, and good 'ol NiCds.

I've tried to do something a bit different this month. With a few exceptions, you can get all the parts from the local Radio Shack store. I built my version from both the junk box and Radio Shack. But before we get too carried away, let's look at how this critter works.

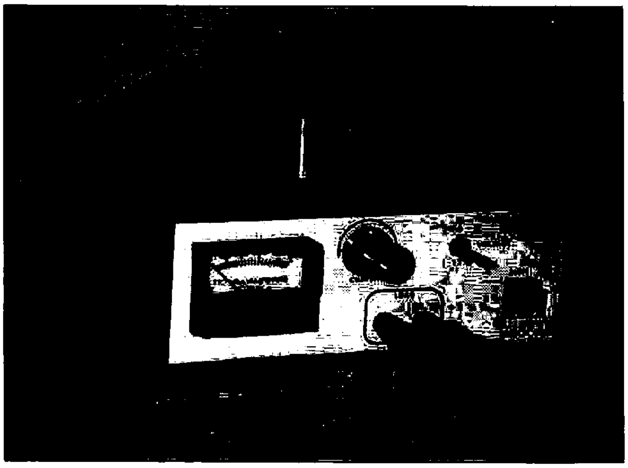


Photo A. The complete charger. Note the 0–500 mA panel for current adjust.

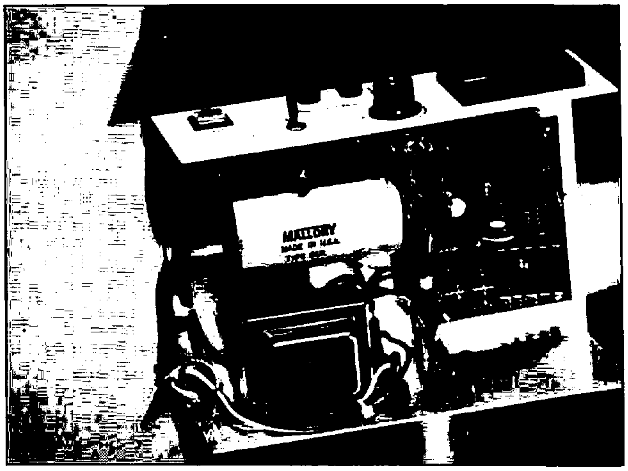


Photo C. Large capacitor IF filter for the 110 volt supply.

Battery Charging Methods

You can charge batteries by several means. Two of the most popular are voltage limiting and current limiting. Current limiting, as the name implies, limits the current going into the battery. The voltage is allowed to move about, but within limits. As the battery becomes charged, the current drops and the voltage comes to rest at the full charge voltage of the battery.

In voltage limiting, the voltage is preset at the full charge setting, and the current is allowed to move about. If a really discharged battery is connected to a constant voltage charger, heavy current will flow into the battery and possibly damage it.

As with all battery chargers and the batteries being charged, the manufacturer has the final say as to how much current and at what voltage the battery will be considered "charged." I've been using Yuasa sealed lead-acid batteries for portable use. They are rated at 20 hours at 60 mA to 10.5 volts (1.2 amp/hour). Great for running HW-8s in the woods. Yuasa recommends, for cycle use, a charge voltage of 14.4 to 15 volts, with the current at 250 mA.

Universal Battery Charger

So, enter the universal battery charger. It's nothing special; in fact, you've probably seen some of the circuitry before. Most of it is tried and true, sure-to-work stuff. Now, that's what we both like to hear, right?

A lot of battery chargers use the LM317 to control the charge voltage. Since I'm not one to re-invent the wheel, I'm going to use it, too. The LM317 comes in many case styles. Radio Shack sells the LM317 in the popular TO-220 case. If you have one in the TO-3 case, so much the better. The TO-3 case seems to dissipate heat better. A trimmer in the adjust lead of the LM317 sets the output voltage. Notice there are two different trimmers. I added a switch to select between two

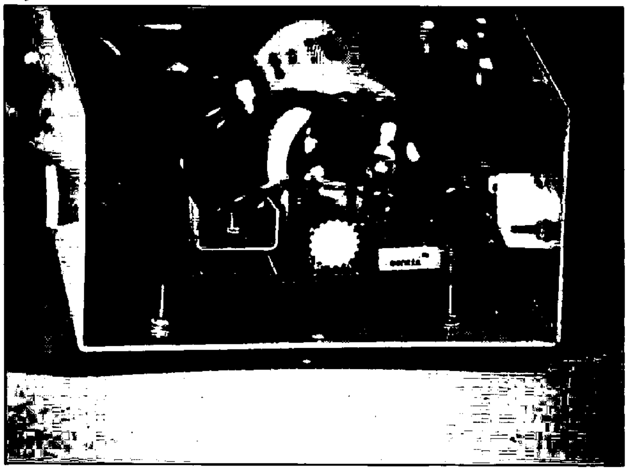


Photo B. Inside view of the charger. Most parts mount on the perfboard.

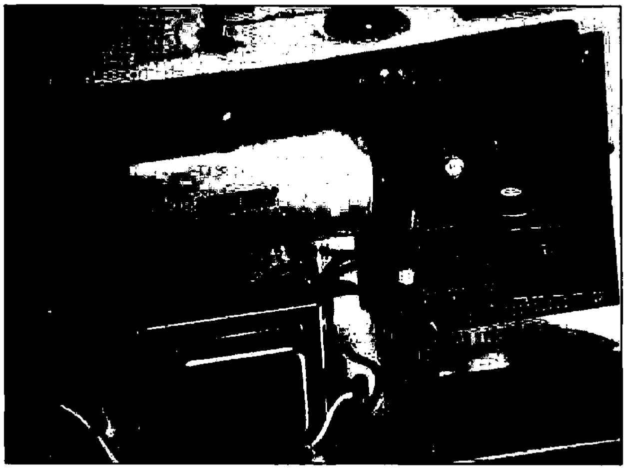
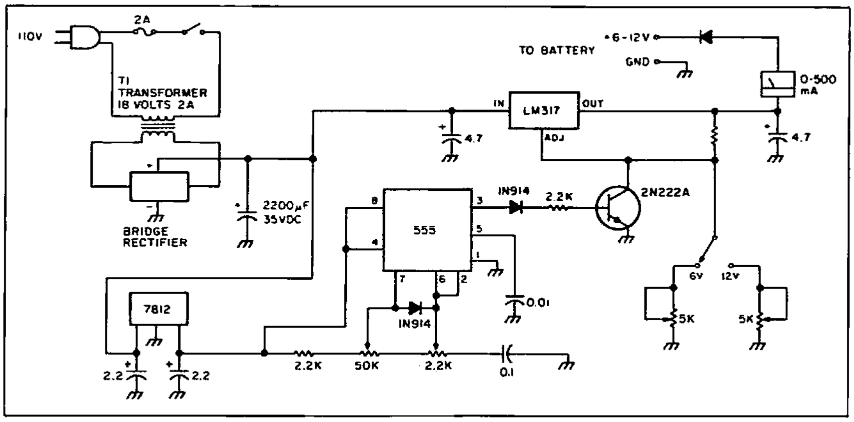


Photo D. Heat sink on LM317. Bridge rectifier is glued to the back panel.

different set points, one for 12 volt charging and the other for 6 volt charging. Now for the added goodies that make this charger a bit different.

Notice that a 2N2222 transistor's collector is connected to the common of the selector switch. When the transistor is off, the regulator operates normally. When the transistor is on, it pulls the ADJ line to ground, through the 220Ω resistor. This turns the LM317 off. Now you're asking, "What turns the transistor on?" Good question. Simple answer. A 555 timer chip, that's what. The 'ol come-to-the-rescue 555 is wired for stable operation. With the components shown, we can adjust the duty cycle of the 555. The more OFF the transistor is, the more current will flow into the battery via the LM317. Less duty cycle, less current.



Schematic for the universal battery charger.

Advantages of Pulse Charging

In other words, we charge the battery by using high current pulses, rather than a constant current. Those 7.2 volt RC batteries are charged just like this. That's why you can recharge one 7.2 volt battery from a car battery in less than 15 minutes. Charge currents can approach seven amps or more, but the duty cycle is low enough to avoid damage to the cells.

By using pulse charging, we can charge the battery without overheating it. The parts passing the current to the battery will also operate cooler. All and all, it's a slick way of charging a battery.

Let's look a bit closer. The timing components adjust the duty cycle of the 555. I've panel-mounted the adjustable control so that I can adjust the current to suit different capacity batteries, with the same voltage. The output of the 555 is a square wave. The more *on*, the higher the duty cycle. You can look at the output with a scope or a VOM. However, you'll only see a voltage move about (as you adjust the duty control) on the VOM due to the meter averaging out the result. The scope will reveal a square wave. Not the best looking waves you've ever seen, but square waves nonetheless, which will turn on the transistor switch.

Time to heat up the soldering iron!

Construction Details

As noted earlier, you can buy most of the parts at Radio Shack. The meter I used in my charger, which has a range of 0–500 mA, came from my junk box. I found it the most useful when setting the charge rate for the batteries.

Most of the circuit is like a circuit for a conventional power supply. T1 supplies 18 volts AC at 2 amps. A bridge rectifier, rated at 4 amps, supplies DC to the filter capacitor. I used a small glob of epoxy to mount the bridge rectifier to the back case panel. The filter capacitor, a computer grade unit, smooths out the DC. Don't worry too much if you can't get the same amount of capacitance I used, just try to get it as large as possible.

A 7812 regulator supplies 12 volts to the 555 timer, since the direct output of the filter capacitor is a bit high for the timer.

The LM317 requires a heat sink. I use a small screw-on unit. If you wish, use the inside back case to heat-sink the regulator. If you do, be sure to insulate the device from the metal chassis.

I mounted the parts, including the trimmer pots, on a Radio Shack copper-plated perfboard. A socket for the 555 makes troubleshooting easier. In point-to-point wiring, keep the heavy current leads short and direct. Attach wire to the battery with five-way binding posts. If you follow the schematic, you'll have no trouble building the charger.

Check over your wiring, especially the 110 volt wiring, for errors. You might want to divide the charger into smaller modules for building and testing. Good idea. Start with the 110 volt side. You should see about 20 volts on the filter capacitor.

With the 555 timer out of its socket, turn on the supply and check for 12 volts on the output of the 7812. While the 555 is still out of the socket, switch the voltage selector switch to either 6 or 12 volts. Adjust the proper trimmer to the finish charge voltage. Switch to the second trimmer and adjust it also. Again, I set mine for 7.2 volts for 6 volt batteries and 14.4 volts for 12 volt batteries.

Turn off the unit and install the 555 timer into the socket. With a battery connected to the output, and the voltage switch set for the proper voltage, adjusting the duty control should make the current meter go up and down. Of course, if the battery is fully charged to begin with, you won't see much current flowing. Because of the blocking diode in series with the output, you can leave the battery connected to the charger and not worry about the battery discharging if the charger is turned off.

That's about all there is to it.

One final point. This unit is only for charging batteries. DON'T try running anything from it. You'll get all kinds of strange results.

With a few changes, you can have a really versatile unit. By using an LM350, output currents of 5 amps are possible. If you build the charger as I did, you can charge up to 1.5 amps. I don't recommend this charger to charge large lead-acid batteries, 105 amp hours or more.

Next time you get the urge to operate out in the field, you won't have to worry about dead batteries! ■

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the June issue, we should receive it by March 31. Provide a clear, concise summary of the essential details about your Special Event.

JACKSONVILLE FL
AUG 5-6

The 1989 Greater Jacksonville Amateur Radio & Computer Show will be downtown at the Prime Osborn Convention Center. Huge air-conditioned indoor swap area, exhibitor's section, forums, programs, FCC exams, prizes, boat-anchor auction. Registration, $5. Swap area tables, $15 for the weekend, $12 Saturday only, $6 Sunday only. Exhibitors contact *Billy Williams N4UF at (904) 765-3230 or (904) 766-2410. PO Box 9673, Jacksonville FL 32208.* For tables, registration, information, (include SASE), contact *Greater Jacksonville Hamfest Association, PO Box 10623, Jacksonville FL 32207. (904) 350-9193.*

MILDORD CT
AUG 5-6

The Greater Bridgeport Amateur Radio Club will hold its special event from Booth Memorial Park at the City-wide Picnic on the 5th, and from the Shakespeare Theater grounds on the 6th. There will be dancing, actors, singers, bands. Club call WA1RJI on 20 meters. Contact *Millie, 11 Pearl Hill St., Milford CT 06460. (203) 874-8740.*

CEDAR RAPIDS IA
AUG 5-6

The Cedar Valley Amateur Radio Club, Inc., is sponsoring their "Summerfest 69" at the air-conditioned Teamsters Hall. There will be amateur radio seminars, FCC exams, a large variety of commercial vendors, a large flea market, and free outside tailgating. One hotel, several motels, and mail nearby. Talk-in on 16/76 and 52. 8-foot tables, $8. Commercial, $15 first table, $10 each thereafter. Admission, $4; age 12 and under, free. *Summerfest 89, Cliff Goldsberry, 2926 Shaffer Drive SW, Cedar Rapids IA 52404. (319) 356-8849.*

RANDOLPH OH
AUG 6

The Portage Amateur Radio Club, Inc., ARRL affiliated, will sponsor its 4th annual Hamfair at the County Fairgrounds. Tickets, $3 in advance, $4 at gate. Children under 12 free. Indoor tables, $8 each. Flea market spaces, $3 each. Activities include forums and nonham activities. Computer hobbyists welcome. Mobile check-in on 145.390 (negative offset). *Joanne Solak KJ30/8, Portage Amateur Radio Club, Inc., 9971 Diagonal Rd., Mantua OH 44255. (216) 274-8240.*

ANGOLA IN
AUG 6

The Steuben County Radio Amateurs present the 29th Annual F.M. Picnic and Hamfest at Crooked Lake. Prizes, picnic BBQ chicken, inside tables for exhibitors and vendors, overnight camping. (County Park charges fee.) Communications on 146.52 and 147.81/.21. Admission, $3. *Donn W. Laird WB9YIT, Steuben County Radio Amateurs, %Lakeland Electronic Supply, 202 W. Pleasant St., Box 330, Angola IN 46703.*

LANCASTER PA
AUG 6

The Red Rose Repeater Association is sponsoring its Computer-Fest at the McCaskey High School. Features: Computer hardware/software, tailgating, prizes. Inside, air-conditioned. Talk-in on 147.015/.615. Admission, $4. Children under 14 free with paying adult. *Computer Fest Committee, PO Box 5092, Lancaster PA 17601.* Vendors contact *Jim Linville, PO Box 5029, Lancaster PA 17601 or Fred Hammersand Tel. (717) 569-1471.*

BERRYVILLE VA
AUG 6

The 39th Annual Winchester Hamfest, sponsored by the Shenandoah Valley ARC, will be at the Clarke County Ruritan Fairgrounds. Admission $5, before July 15, $4. Children under 12 and nonham spouses free. Tailgaters and limited tables, $7. Commercial exhibitors. Donations from major manufacturers. VE exams. Talk-in on 146.22/.82 and 146.52 simplex. *Joanne Blaker WB2CMV, (703) 869-4878. Or, SVARC, PO Box 139, Winchester VA 22601.*

GREENFIELD IN
AUG 6

The Greenfield Amateur Repeater Association Hamfest will be at the 4H Fairgrounds. Admission, $5; children under 12 free. Flea market. 8-foot table, $5. Commercial Bldg. $7. Tailgate, $2. Talk-in frequencies 147.000+ or 444.725+. *Keith Dalrymple N9GWK, 2210 Wayne Dr., Greenfield IN 46140.*

RHINELANDER WI
AUG 12

The 10th annual Rhinelander Swapfest, sponsored by the Rhinelander Repeater Association, the Northerwoods ARC, and the Tomahawk Repeater Association, will be at the Ice Arena. VEC testing, free parking, dealers welcome. Admission, $1; tables, $5 each prepaid by July 31; bring your own tables, $3 per space; outside tailgating, no charge. Rhinelander Repeater 146.34/.94. Tomahawk Repeater 144.83/145.43. *Leonard Bauman K9RMN, 804 Lincoln Street, Rhinelander WI 54501. (715) 369-3296/5564.*

ESSEX JUNCTION VT
AUG 12

The Burlington ARC will hold its annual hamfest at the Champlain Valley Fairgrounds. Admission, $4 (Canadian, $5). Children under 12 free. Camping available. Talk-in on 146.34/.94. *Barb Kimball N1DLE, 1 Sundown Drive, Williston VT 05495. (802) 878-5555.*

FAIRMOUNT IN
AUG 13

The Grant County ARC will hold its annual swapfest at the Fairmount Play Acres Park. No ticket, no charge, bring lunch, table, chairs. Talk-in on 146.19/.79. *Dennis Clevenger KA9JUB, 516 S. Walnut, Fairmount IN 46928. (317) 948-9351.*

WARRINGTON PA
AUG 13

The Mid-Atlantic ARC hamfest will be at the Bucks County Route 611 Drive-In Theatre. Tailgating spaces, $2 each. Admission, $3. Talk-in on 147.06/R and 146.52/S. *Al Maslin W3DZI, (215) 446-4936. Or write MARC, PO Box 352, Villanova PA 19085.*

ST. CLOUD MN
AUG 13

The St. Cloud Amateur Radio Club Hamfest will be held at Whitney Senior Center. Tickets, $3; additional tickets, $2. Prizes, talk-in on 34/94 primary, 615/015 secondary. *Scarc, Box 141, St. Cloud MN 56302.*

GEORGETOWN KY
AUG 13

The Central Kentucky ARRL Hamfest, sponsored by the Bluegrass Amateur Radio Society, Inc., will be at the Scott County High School. Technical forums, license examinations, awards, and commercial exhibits in air-conditioned facilities. Outside flea market space free with admission. Tickets $5 in advance, $6 at gate. Talk-in on 146.16/.76 repeater. *Bill DeVore N4DIT, 112 Brigadoon Parkway, Lexington KY 40503.*

VALPARAISO, IN
AUG 13

The Porter County Amateur Radio Club presents the Annual Northwest Indiana Hamfest and Computer Fair at the County Fairgrounds and Expo Center. Features: Walk-in VE testing, large flea market, and many commercial vendors. Talk-in on 146.775/.175 or 146.52. Admission, $4 at the gate, $3.50 in advance. Kids under 12 free. *Hamfest Committee, PCARC, PO Box 1782, Valparaiso IN 46384.*

BRIDGEWATER NJ
AUG 16-18

The Somerset County Office of Emergency Management will operate WC2ADK from 1400-0100Z each day. R.A.C.E.S. and Public Service at the annual 4-H Fair. Suggested frequencies: lower 25 kHz of General 80-10 meters and 10 meter Novice; visitors on 145.320 simplex. Send QSL and SASE to *Somerset County OEM/4H, PO Box 3000, Somerville NJ 08876.*

SCARBOROUGH ONTARIO
AUG 16-SEP 4

One of Canada's most ambitious amateur radio exhibits will again be part of the Canadian National Exhibition. The VE3CNE Exhibit will be in the Arts & Crafts Building. Take time to operate the station. Listen for VE3CNE on all the HF bands, apply for a colorful QSL card. *VE3CNE Executive Committee, 44 Innisdale Road, Scarborough, Ontario CANADA M1R 1C3.*

POMONA CA
AUG 19

The Tri-County Amateur Radio Association is sponsoring its Hamfest '89 at the Palomares Park Recreation Hall at Orange Grove. Indoors, free parking, prizes, ARRL booth, VEC exams, admission, $3. $3 per table, $5 nonmembers. No personal tables. For preregistration and table reservations, contact WB6UFX. For exams, send SASE, 610, original license and copy of current license, photo I.D., $4 to *TCARA, %Joe Lyddon WB6UFX, 6879 Sard St., Alta Loma CA 91701. (714) 980-4563.*

OAKLAND NJ
AUG 19

The 13th annual Ramapo Mountain Amateur Radio Club Hamfest & Computer Flea Market will be at the American Legion Hall and Grounds. Indoor and tailgate vendors, VE exams, prizes. Talk-in WA2SNA/R, 146.49/147.49, 146.52/.55 simplex. Details on WA2SNA-1 PBBS. *Marc WA2S @WA2SNA packet or (201) 652-1318/8493.*

ITHACA NY
AUG 18

The Fingers Lakes hamfest, sponsored by the Tompkins County Amateur Radio Club, will be at the 4H-Acres. Admission, $3. Under 18, free. Tailgaters, $1. Indoor tables, $5 each. Overnight camping, vendors. handicapped parking. Talk-in on 37/97. *Bob KD2IM AT, (607) 347-4444.*

VICTORIA TX
AUG 19

The Victoria and Port Lavaca Amateur Radio Clubs are sponsoring their annual swapfest at the Knights of Columbus Hall. Raffle chance included with admission ticket. Prizes, barbecue, VEC exams, displays, and programs for hams and nonhams. Talk-in on 145.19 (Victoria) and 147.02 (Port

Lavaca). *Gary Garnett AA5JT, PO Box 7025, Victoria TX 77905; or Lynn Hewitt K8KKD, PO Box 330, Port Lavaca TX 77979.*

TACOMA WA
AUG 19–20

The Northwestern Division Convention and Tacoma Hamfair, sponsored by the Radio Club of Tacoma, will be at Pacific Lutheran University. Admission, $5 till Aug. 6, $7 at door. $1 for nonhams; 12 and under, free. Flea market, tables $18 (includes registration), commercial exhibits, exams. RV parking (no hookups), $2.50 each night; dormitory rooms (no reservations required), $15 single, $22 double. Entertainment, banquet program, activities, displays, technical seminars. Pacific Rim Disaster Team presentation, "Radio Communications for the Armenia Earthquake." *Radio Club of Tacoma, PO Box 11188, Tacoma WA 98411. (206) 759–2040 or Bill Morgan W7GPR, (206) 531–3821.*

HUNTSVILLE AL
AUG 19–20

The Huntsville Hamfest 1989 will be at the Von Braun Civic Center, the site of the 1989 ARRL Southeastern Division Convention. Free public admission; free electricity in each booth; free coffee and doughnuts each morning; and free catered lunch both days. There is no charge for attending any part of the Huntsville Hamfest. There is a charge for booths. Send for information packet. *Art Davis WB4KKA, Dealer Show Chairman, (205) 883–0477. John Morris K4XH, Assistant Chairman, (205) 859–3994. Huntsville Hamfest, Inc., 2804 S. Memorial Parkway, Huntsville AL 35801.*

W. LAFAYETTE IN
AUG 20

The Tippecanoe Amateur Radio Association will hold its 18th Annual Hamfest at the Tippecanoe Fairgrounds. Tickets, $3. A large flea market, dealers, and forums will be featured. Talk-in on 13/73. *D.C. Roberts, 5124 Jackson Highway, West Lafayette IN 47906.*

TOKYO, JAPAN
AUG 25–27

The Japan Amateur Radio League will hold their HAM FAIR '89 at the New Hall (Shinkan) of the Tokyo International Trade Center In Harumi, Tokyo. The two principle themes of the event are: enjoy Cycle 22 more fully by operating new bands and support the success of new Amateur Satellite JAS-1b. 90 manufacturers and dealers, outdoor flea market, display of vintage transmitters, CW contests, technical forums, do-it-yourself workroom, best home-brew contest, display and sales of ARRL publications. Tickets, good for all three days, are 900 yen for adults, 400 yen for children under 15, and will be sold at the gate. *JARL 14-2, Sugamo 1-chome, Toshima-ku, Tokyo 170, JAPAN; PO Box 377, Tokyo Central Post Office 100-91, JAPAN. Tel. 81-3-947-8221. FAX: 81-3-943-8282. Telex: j 23868 JAPRETAR.*

DAYTON OH
AUG 26–27

The Dayton Microcomputer Association, Inc., presents Computerfest™ '89, the 14th annual Computer and Electronic Convention and Flea Market indoors at the Hara Conference & Exhibition Center. Dealers, speakers and seminars, demonstrations, user group and club displays, prizes, free parking. Admission, $3 each day. Children under 12 free. Special offer for groups. *(513) 263–FEST (general and vendor information). Mark Hanslip, 143 Schloss Lane, Dayton OH 45418 (vendor information). BBS, (513) 293–1754; parameters 300/1200/2400, 8, 1, none.* For placing an ad, contact by July 31, *Dave Taylor, 3030 Viola Drive, Beavercreek OH 45385. (513) 426–7650.*

MARYSVILLE OH
AUG 27

The Union County Amateur Radio Club announces its 14th annual "Marysville Hamfest" at the fairground. Free overnight camping, entertainment by the "Ham Band," admission $3 in advance, $4 at the gate. Indoor and outdoor flea market space available. *The Union County Amateur Radio Club, 13613 US 36, Marysville OH 43040. (513) 644–0468, W8BJN.*

DANVILLE IL
AUG 27

The 21st annual Danville Area Hamfest will be at the UAW #579 Civic Center. Tickets, $2; or three for $5. Talk-in on 146.82. Cookout. FCC VE testing, walk-ins welcome. Bring ID, $4.75; if upgrading, bring your original license and a copy to send with the 610. Overnight OK, but no hookups. Prizes. *John Cunningham WA9WJG, 1703 E. English, Danville IL 61832. (217) 443-0100.*

LEBANON TN
AUG 27

The Lebanon Hamfest, sonsored by the Short Mountain Repeater Club, will be at the Cedars of Lebanon State Park. Outdoor facilities only, exhibitors bring your own tables. Talk-in on 146.31/.91. *Mary Alice Fanning KA4GSB, 4936 Danby Drive, Nashville TN 37211. (615) 832–3215.*

ST CHARLES MO
AUG 27

The St. Charles ARC will sponsor HAMFEST89 at Blanchette Park. Forums and license exams, free admission and parking. Handicapped parking available. $2 per space for tailgate flea market. Dealers welcome in air-conditioned halls. Talk-in on 146.07/.67, 444.65/449.65 repeaters and 146.52 simplex. *Mike Nolan KA0UXQ, 16 Gateswood Drive, St. Peters MO 63376.*

Number 31 on your Feedback card

ABOVE AND BEYOND

VHF and Above Operation

C.L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake
San Diego CA 92119

Our Amateur Microwave Bands					
METER	**GHz**	**(1000 MHz)**	**METER**	**GHz**	**(1000 MHz)**
33cm	0.902 – 0.928		12mm	24.0 – 24.25	
23cm	1.240 – 1.300		6.4mm	47.0 – 47.4	
13cm	2.300 – 2.310		4.0mm	75.5 – 81.0	
9cm	3.300 – 3.500		2.5mm	119.98 – 120.02	
6cm	5.650 – 5.925		2.1mm	142 – 149	
3cm	10.0 – 10.50		1.2mm	241 – 250	

24 GHz Operation

Equipment for 24 GHz seems to be very scarce. Recently, I heard a new word to describe it—"unobtainium." Well, there is good news which I hope will put you at ease: you can obtain materials inexpensively. You may have to dig a little to locate surplus materials, but not for long. Several commercial systems are being constructed which will contribute to the surplus market in a few years.

I know of two units you can use on our 24 GHz band. They are available from Microwave Associates and California Eastern Labs. Microwave Associates makes the familiar Gunnplexer units for 10 GHz, and a similar unit for 24 GHz which costs about $350. According to MA/COM, the unit's features are similar to the 10 GHz unit. It has a circulator/detector in the output, and varactor tuning of the Gunn source. These features are essential for a high performance unit.

The 24 GHz Gunn oscillator/detector device, the NEC ND-610AAM, is available from California Eastern Labs. It is a basic setup intended for alarm applications, without the added features of the MA/COM device. This inexpensive unit has a waveguide detector and an approx. 10 mW Gunn source (no varactor tuning). You can adjust the unit mechanically as well as by Gunn voltage tuning.

One word of caution to users of 10 GHz systems: You need to modify the Gunn DC voltage supply to connect the 24 GHz unit to your 10 GHz wideband FM system. The 10 GHz system Gunn runs on a 10 volt supply, while the 24 GHz Gunn device requires 7 volts maximum. Accidentally connecting the 10 volt supply to the 24 GHz device would destroy it. Be careful—one mistake is COSTLY.

Preliminary tests on one of the NEC ND610AAM Gunn oscillators prove it to be a fast way to get on 24 GHz with minimum cost ($50). It's available from California Eastern Labs 3260 Jay Street, Santa Clara CA 95954. Tel. (408) 988-3500. Quite a bargain.

Test Equipment Limits

My only trouble working at this frequency was finding test equipment. In the surplus market, test equipment usually stops at 18 GHz. Most pieces of equipment on my test bench are older Hewlett Packard units, like the 5245 frequency counters, which go to only 18 GHz. My power meters are rated to 12.4 GHz. With an external detector, my spectrum analyzer can go above 12.4 GHz. This was the only tool I had for setting frequency. Kent Brittan WA5VJB found a wavemeter that covers the 24 GHz band, and I plan to keep a lookout for one for my shack.

Unit operation was little unstable without a circulator. Waving my hand in front of the antenna caused the oscillator to shift frequency quite a bit. This occurs on 10 GHz in simple wideband units, but it was more pronounced on the 24 GHz oscillator.

Commercial equipment for this band is being made for short distance point-to-point-to-point telephone communications by some companies, such as Raycon and MA/COM. The Raycon system, for short range communications (15 miles), usually involves multiplexed (many) telephone circuits on one microwave frequency. Their brochure states that they use wideband FM, and have the capability of 192 channels available for two-way voice communications on one 24 GHz microwave system.

The limitations on these systems and on amateur applications are the same, however. Narrowband systems, which are becoming more popular in amateur applications, give a greater range than their commercial counterparts. Narrowband signals better tolerate a noisy path.

However, all is not rosy. Transmission through a normal atmosphere shows an average loss of 0.02 dB per mile at 10 GHz, and a loss of 0.2 dB per mile at 24 GHz. When it rains, these losses almost double the loss over those on a dry day (see Figure 1). Additionally, the loss figure suddenly peaks at the 24 GHz range due to the absorption of water vapor in the atmosphere. Some people suggest we were given this band because of the high loss due to water vapor absorption, but other bands have this problem. The first oxygen absorption band is 65 GHz.

Field Tests

Several local amateurs bought equipment from California Eastern Labs and conducted tests between San Diego and Los Angeles. Experimenting with mobile operation on 24 GHz from the Los Angeles area produced successful results. Jack N6XQ (mobile in Los Angeles) made many contacts with Alan Packer WA6CPL, who was operating from his home QTH. N6XQ made several successful contacts, from stops along the highway on his return trip to San Diego, to further test 24 GHz operation. The last 24 GHz contact on his return trip was from a spot near the Camp Pendleton USMC base, about 50 miles south of Los Angeles. Signal strength was still good, and he made the contact with little difficulty.

We made the next contact from San Diego from N6XQ's home location, a spot on Point Loma which has yielded good 10 GHz contacts to Los Angeles before. However, several tries from Jack's QTH in San Diego on 24 GHz to Los Angeles proved futile. The path is over water to Los Angeles for about 100 miles. We made 10 GHz wideband contacts easily, with approximately the same power output levels. Finally, after many attempts over several weeks, we made a two-way con-

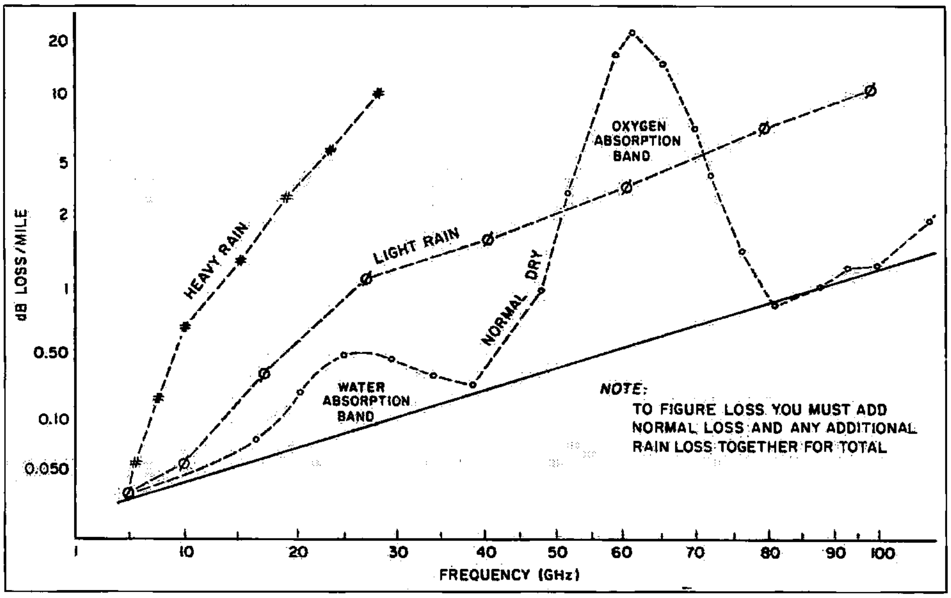


Figure 1.

continued on p. 82

continued from p. 54
can assume identical results for the transmitted signal.

Symmetry Comparisons

With a symmetrical, dual-radiator antenna system, you can compare the two individual radiators. You can run listening tests by switching from one radiator to the other and often detect any defects from the outset. I compared each of the three radiator types—the dipole, COCOA-2, and COCOA-3—with its counterpart before progressing to the next, more complex configuration. In each case, listening tests showed the two radiators identical, within the 1-2 dB accuracy of the measurement method.

Front-to-Back Measurements

After finishing the tests above, I ran extensive listening tests, using the foreshortened model, to determine the overall feasibility of these configurations. Front-to-back ratios for each of the radiator combinations averaged 10-15 dB. Principal directivities in this installation are in the east-west direction (elements run north and south). However, with the two radiators connected *in-phase*, both the COCOA-6 arrangements gave an F-to-B of up to 30 dB and signal strengths approximately 4 dB stronger for stations to the south, compared to the single radiator of the same type. Repeating this comparison for the dipole radiators yielded only a 2 dB change.

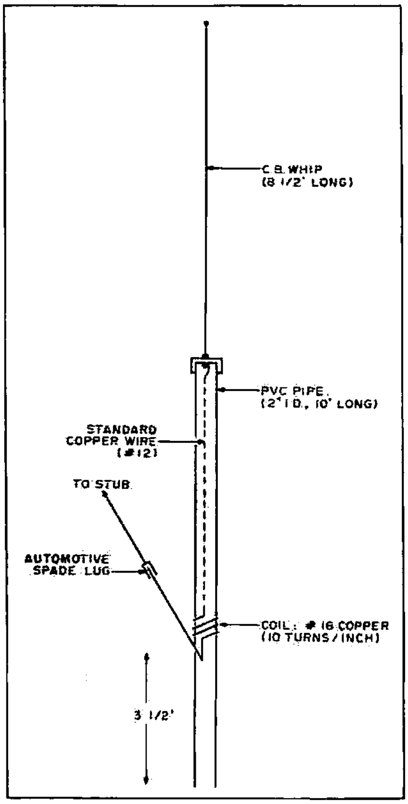


Figure 8. Detail of vertical terminations.

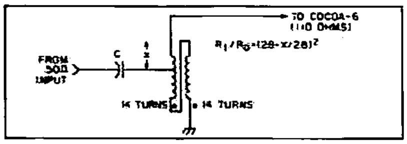


Figure 9. Diagram of toroidal matching transformer.

Gain Considerations

I found a loss of 10 dB for a dipole at a height of 12 feet, compared to an identical dipole at a height of 61 feet. This is about equivalent to the gain of a typical linear amplifier! Keep this in mind when evaluating data for the foreshortened COCOA-3 radiators.

Figure 7 shows that the two foreshortened radiators, with the high induction fields of their loading coils on either end of the high dipoles, are close enough to the ground to have appreciable comparative ground losses, perhaps in excess of 10 dB. See Figures 10a and 10b. Using the high dipole mentioned above for comparison, we see that, for a level COCOA-3 radiator, the effective radiation from the three dipoles located collinearly is *3 x P/3*, or *P*. That is, nearly all of the power is effectively radiated. However, referring to Figure 10b, if we assume that the two low dipoles are each down by 10 dB in effective radiated power (equivalent to the 12-foot-high case), the resulting effective power from the three dipoles is only *0.4P*. In other words, expect the output to be down approximately 4 dB from the high dipole.

Signal Strength Comparisons

I made extensive dB comparisons, using the receiver mentioned above. The east and the west COCOA-2 and COCOA-3 were compared with the opposite standard dipole using signals at various distances and times of day.

The signal strengths from both of the compound radiators showed losses compared to the reference dipole. Specifically, the COCOA-2 measured about 3 dB down and the COCOA-3 measured about 6 dB down, compared to the dipole. Recall though, that for the uncompromised antenna shown in Figure 4, if all four terminations are located at the highest practical height (60 ft.), the gain would be 8 dB over a dipole—the kind of gain one would expect in a 4-element rotary beam!

Conclusion

This article described a practical design of a 6-element, direction-switching phased array antenna system for 75 meters. This system features two coaxial, collinear radiators, each comprising three half-waves in phase. You can control directivity and angle of radiation by switching delay lines in the coaxial feed system. A version of this system, using inductively foreshortened elements close to the ground, has been constructed and used to evaluate gain and front-to-back ratios. Height above ground is all-important! ■

References

[1] "A Balanced Dipole Antenna," by J.E. Taylor, *73 Magazine*, October 1973, page 57.

[2] "A Low Frequency Phased Array," by J.E. Taylor, *73 Magazine*, July 1974, page 49. Also, "An 80 Meter Phased Array," by J.E. Taylor, *73 Magazine*, March 1975, page 52.

[3] "The 80 Meter Pile Crusher," by J.E. Taylor, *73 Magazine*, June 1978, page 76.

[4] "A Portable Coaxial Collinear Antenna," by B.B. Balsley and Warner Ecklund. *IEEE Transactions* on Antennas and Propagation, July 1972, pages 513-16. See also *Radio Communication*, September 1972, page 597.

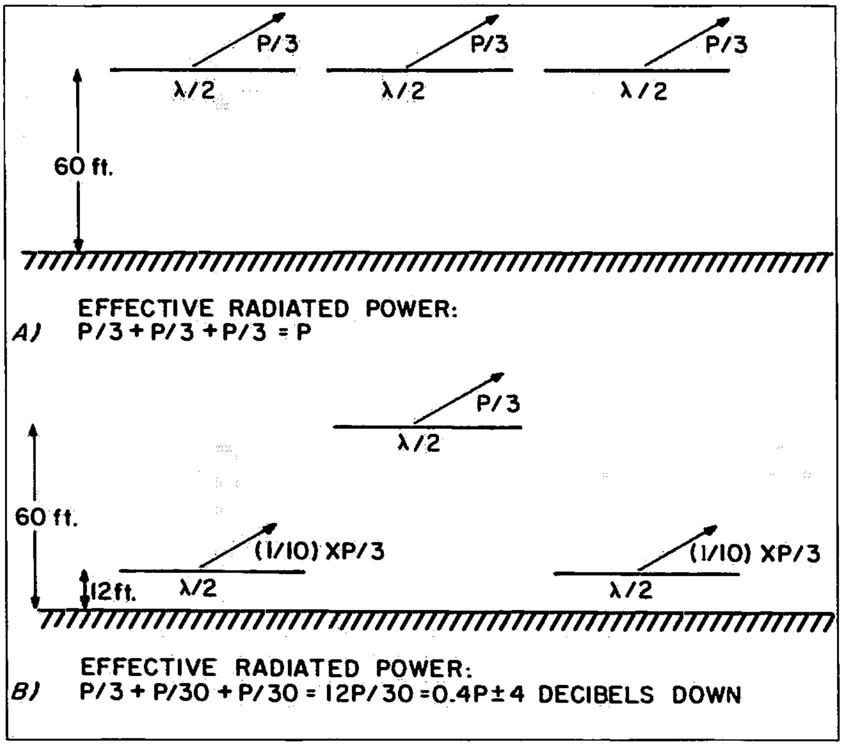


Figure 10. Calculated gain difference between a) an antenna whose three half-wave elements are all up at 60 ft, and b) an antenna whose two outside half-wave elements terminate at only 12 feet above the ground. Ground absorption at low frequencies greatly reduces antenna gain.

ADVERTISERS

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*Advertisers who have contributed to the National Industry Advisory Committee(NIAC).

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are no such RFI problems in your setup. You can make L1 and L2 by winding 50 turns of #26 wire on an Amidon T-37-2 (red) toroidal core. M1 is a 50 microampere lighted meter for nighttime use. R1 is 18k for the TR-7950.

An optional LED bar graph indicator (U3 and associated components) tracks the 50 microamp meter movement. The LEDs are handy for checking noise or signal level out of the corner of your eye on night hunts. Use a variety of colors to aid visibility if you wish.

Vince built his meter amplifier on a predrilled grid board, Radio Shack part number 276-158. There's plenty of room to add other goodies, such as the internal attenuator from the March 1989 "Homing In" column. Use sockets on the ICs for ease of setup and troubleshooting. Make the three connections from the radio to the box (S-meter, noise meter, and ground) with ribbon or other multiconductor cable.

Metering a Dual-Bander

Hunts on 220 MHz are gaining in popularity, as are dual-band rigs such as the Kenwood TM-621A. WA6DLQ recently got one and modified his noise meter box for use with it. The TM-621A is a very compact unit with surface-mount components. I suggest you get the service manual for it, or any other rig you wish to modify, to aid in locating tap-off points.

Noise meter input on the TM-621A comes from signal SQ-1 at the connector on the main board. With no signal, there are 0.6 volts present at SQ-1, dropping to 0.55 volts with the squelch open. This shift is much smaller and of opposite polarity to the shift in the TR-7950, so an amplifier/inverter stage is used. U2b and associated components in the inset box in Figure 2 replace R4–R6, connecting at points A and B.

Tap off signal SQ-1 without disturbing the delicate surface mount PC boards by removing the proper pin from that connector, soldering the added wire to the pin, and then reinstalling the pin into the connector and plugging it back in. S-meter pickoff for the TM-621A is at test point TP-1, which has +4.85 volts at full scale. TP-1 sticks out of the two meter board in the TM-621A. R1 in the meter amp is changed to 120k because of the higher signal level.

Checkout and Operation

For initial checkout, leave U1 and U2 out of the sockets. Apply +12 volts input, close S1, and measure the voltage at the output of regulator U3. If it's not close to +9 volts, change R13 as necessary. For the TM-621A, adjust R16 for 0.6 volts at the tap of the pot. Connect +9 volts to U2-1 with a clip lead and adjust R10 for exactly full scale on M1.

Now, turn off the power, remove the clip lead, and install U1 and U2. Set S2 to the "S" position, and apply a strong on-frequency signal to the receiver. Adjust R2 for exactly full scale on M1. Adjust R11 until all except the last LED comes on, then slowly increase R11 until that last LED just comes on.

Set S2 to the NOISE position and adjust R5 or R21 for exactly full scale on M1, with the strong signal still applied. For the TM-621A, remove the signal and adjust R16 to zero the meter. Repeat the adjustments of R21 and R16 if necessary.

For hunting, adjust the squelch control in the rig to get a near zero reading on the noise meter when there's no signal coming in. Weak signals will then move the noise meter upscale. You'll be amazed how easy it is to get bearings on them! Switch to the S-meter position as signals become stronger and the noise meter tops out.

Remember: I said that there are two methods for noise metering. If you can't find a good DC take-off point in the squelch circuit of your particular VHF-FM receiver model, you can use the second method. Tap off the noise at the discriminator and build an external high-pass filter, noise amplifier, rectifier, and meter amplifier. It's easier than it sounds. A schematic and full details are in the T-hunt book. (Moell and Curlee, *Transmitter Hunting—Radio Direction Finding Simplified,* TAB Books #2701, p. 156. Available from Uncle Wayne's Bookshelf.)

How do you hunt when the hider is varying the transmitter power, making both the S-meter and noise meter bounce around like crazy? You'll want RDF equipment that does not depend on signal amplitude to obtain bearings. We'll discuss such units in the next column. 73

LETTERS

From the Hamshack

Hypocrites?

First you guys complain that code is an unworthy item which should be eliminated, then you'll have some article on how easy it is to learn 5 wpm. I really don't get it, such hypocrisy! I think your goal is to sell more magazines to the new hams.

Robert Wright, Radio Officer
US Merchant Marine
Lt jg USNR

Code is still required for the ham ticket, and as long as it is, we will run articles on how to study it. Furthermore, since some people actually enjoy learning and using code, we will run the occasional code study article, even when a no-code license comes about.

The code controversy is widespread, and we try to present as many thoughtfully conceived opinions as possible, pro and con (see "Letters" in the June issue). Many of us believe there should be some type of license which does not require code, but that does require stiffer testing in theory and practice.

You are right about selling more magazines to new hams. In fact, we believe every ham should read 73—there is something in it every month for everyone...

Linda Reneau, Senior Editor

Alternatives to the CW Exam

There are many possible alternatives to the CW exam which would enrich, rather than cheapen, the ranks of operators. For example, why not a stringent exam on emergency operating procedures? How many hams today could, in a true emergency, function immediately as competent, professional conduits of information between agencies and people? Alternative licensing modules to the CW exam could be much harder than CW, and yet make our hobby more accessible to many people.

We can no longer continue to see ham radio shrink, and console ourselves with the thought that at least we kept out the CBers—because we are also keeping out the people we need to attract the most! If ham radio doesn't expand and attract more of the best and the brightest in electronics, our children may never have a chance.

I have been a licensed ham for thirty years. Recently I attended an ARRL forum to come to some understanding of why the ARRL seems so dead-set against any attempts to replace the CW requirement. I was very personally disappointed in the ARRL representative, as he repeatedly confused a no-code license with a no-work-to-get license.

It's time all hams rallied around some plan to strengthen our hobby and bring it into the twenty-first century. I think the first step on such a plan must mean that we have to make one thing very clear: that a no-code license should be, could be, and would be, a license that a person would have to work very hard for, in a dedicated and professional manner.

Neil Shapiro WB2KQI
Bethpage NY

Hear, hear, Neil!

CW—Not Just A Filter

It seems most people believe that the CW requirement is a way of weeding out riff-raff from our valued ham bands. Some argue that CW is out-moded and useless compared to the new digital modes.

RTTY, AMTOR, and packet, can be fast and accurate, but there's one very important fact: CW works during propagation conditions where the digital modes—even voice modes—fall down. How much more reason do you need to keep the requirement?

Ronald Scott Gray N7CTF
Glasgow MT

Another Success Story

About three years ago, my school received a grant of $8,000 for a program called "the communications option." This meant constructing a radio station to train our students with the techniques of a disk jockey and commercial radio station management. After spending half the money, the school administration asked me to think of a way to spend the other half, and I said I would begin a program on amateur radio, about which I knew practically nothing at the time.

I received lots of material and help from the ARRL and designed a course to prepare 17 students for the Novice exam. I bought a Kenwood 940 S/AT and accessories. I also purchased a tower, rotor, A-4 beam, and other things.

We all studied code and theory from *Tune in the World with Ham Radio,* then called two amateur operators from Queens College to examine us. We all passed, had a big party, and assembled a station.

Every one of those kids got on the air, made CW contacts, exchanged QSL cards, and had a lot of fun. The following year, they all went off to college and took with them something besides a high school diploma. Since that first group, we have continued the program and we have just licensed another 14 students.

Well, Wayne, this letter is to tell you that ham radio is not dead in some schools. There is also a loose knit group of amateur radio operators led by Marty Smith in the New York City School System. They are completing an amateur radio curriculum for students in the elementary through secondary grades.

Bob Weinstein KE2FE
Richmond Hill NY

What Cheek!

You're really asking for it. What an idea, that we should allow gay amateurs to use the airwaves and advertise in *73*. Nonetheless, I think the idea is a good one. Would you allow your advertising staff to refuse an advertisement from a group of YL hams? No? Then how about German-speaking hams? Or maybe even Asian or Jewish hams?

The fact is pretty well proven that gay folks have no more choice about who and what they are than a Jew or Arab has. They have every right to live with as much freedom as everyone else, as long as they harm no one. That includes the right to get a license, to use the airwaves in accordance with regulations, and, yes, to organize and meet with others of similar background and experience. For *73* to print an advertisement from a group of gay hams (assuming the ad itself is not offensive) does not constitute an endorsement of anything other than the right of these people to exist. You do believe in that right, I hope. Allowing them to advertise in *73* would seem consistent with your history of backing progressive ideas. Frankly, I was surprised and disturbed that there should be any question at all over this issue. By all means, print the ad, and continue to print it. Set an example for those people who insist on being blinded by their own prejudice.

Gary Lee Phillips KA9NZI
Chicago IL 60640

If we can't be blinded by our own prejudices, whose prejudices can we be blinded by? Gary, you're a trouble-maker. . . Wayne

Lambda ARC

In his "Never Say Die" column in May, Wayne Green asks for input from the readers as to whether or not *73* should run a classified ad from our gay and lesbian ham radio club. The readers might find the following information about our club useful in considering the question.

The purpose of Lambda Amateur Radio Club is to provide its members with opportunities for friendship, promote good fellowship, provide support and technical assistance, and facilitate enjoyment of the hobby. We are also dedicated to providing public service and promoting the amateur radio service.

Our club has assisted individuals in obtaining their tickets and helped inactive hams rekindle their interest. Our club is international, with 112 members in the US, Canada, and the United Kingdom. We publish a monthly newsletter containing technical and human interest articles, and we maintain a lending library of study materials for those wishing to obtain an amateur radio license or upgrade. We sponsor member nets which encourage members to operate in a variety of modes, and we sponsor an awards program with certificates for proficiency.

We wish to advertise in *73* simply to reach other individuals who might be interested in our club. Our club shares at least two important goals in common with all concerned amateurs: adding as many new hams as possible, and strengthening the amateur radio service. Last year, we increased our club membership by 60 percent, in spite of the fact that we have not been permitted to publicize our existence in mainstream amateur radio publications. We are confident that we can do our part to turn around the decline in our hobby if we're given a chance.

Jim Kelly KK3K, President
Lambda Amateur Radio Club
Philadelphia PA 19130

Number 34 on your Feedback card

TECH TIPS

Pearls of Tech Wisdom

TVI Snake in the Grass

My friend's older tube final rig was driving him nuts, even though it seemed like he had checked out all the suspect circuitry.

He consistently overlooked, however, the plate chokes (56Ω, 1 watt resistors with four turns of wire). I snipped the resistor choke wires and found one resistor reading 7Ω and the other about 12Ω.

These things are sort of a shock absorber in that they pass everything under 30 MHz and inductively stop and resistively dissipate those components higher in frequency. The problem is that the wattage is too low, and the "Q" of the surrounding wire-wound coils is willy-nilly.

My solution: I replaced them with 2 watt units, wound with four turns of "solder wick," and added a ferrite bead at the plate cap ends of the unit. I obtained the ferrite beads from a Radio Shack ferrite pack. Any bead that will slip over the end of a 2 watt resistor lead will do nicely.

Now he's on the air, and the neighbors are off his case.

Terry F. Staudt WØWUZ L.P.E.
Loveland CO 80537

TS-930 AMTOR Keying Mod

(Reprinted from January '89 *NCARC Communicator*) First, go to the signal board and locate C500. C500 is a 4.7 µF electrolytic near the center of the board (if viewed with radio upside down, with the front facing you) near connector 30. Remove this capacitor by twisting it with a pair of needle nose pliers. This capacitor cannot be removed any other way without complete disassembly of the radio. Its function is to debounce the PTT switch and is a big reason why the 930 will not work satisfactorily in AMTOR mode.

The next step is to ground one leg of R476. This resistor is on the same board just above the large CW filter. The lead of R476 that is exposed is on the side of the resistor that needs to be grounded. An easy and foolproof way to do this is to locate R474, right next to R476, and scrape some of the insulation from both of the exposed leads and solder a bridge between them. Note: The leads that are not easy to get to are not the ones to worry about.

These modifications are recommended by Kenwood and will prove to be very satisfactory.

W5AU

Removable Weatherproofing for Connectors

Every time I work on my outdoor antenna system, I find that I need to weatherproof a few coaxial connectors. After all, coax is expensive and I don't want moisture to get inside of it and spoil it.

Over the years I have used silicon glues, butyl caulk, plastic electrical tape, and recently a shoe repair glue. All provided protection, at least initially. Although the shoe glue and the butyl caulks lasted very well, they were murder to remove from the connectors when I wanted to open them.

I recently came across a new product that weatherproofs very well, but allows me to open the coax connectors when necessary. Star Brites® Liquid Electrical Tape, available in several colors, is a liquid vinyl which seals out moisture and prevents corrosion in wires, terminals, and connectors. It dries to a flexible coating.

Star Brite comes in a can with a brush applicator attached to the screw-on cap. Just brush the liquid onto the exterior surface of your coaxial connectors, being sure to coat all joints and an inch or more of the coax sheath. Allow it to dry for five minutes.

This product was tested by UL (Underwriters Laboratory) and found to offer better dielectric properties than plastic electrical tape.

I found that it was no problem to remove the coating of Star Brite on coax connectors with my pliers and a pocket knife. Porous surfaces were another story. The coating does not come off of them very well.

Star Brite Liquid Electrical Tape is available in 4 fl. oz. cans for $5, and in 2 lb. cans for $25. The manufacturer states it is available at True Value Hardware stores or direct from *Star Brite, 4041 S.W. 47th Ave., Ft. Lauderdale FL 33314. (800) 327-8583.*

Bill Clarke WA4BLC
Falls Church VA 22042

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continued from p. 76

tact on a cold day, with low humidity, a condition here in California that we call an on-shore flow. The relatively dry air from the land mass flows out to sea.

The 24 GHz contact made over this 100 mile path was poor quality, and we didn't make a full exchange. We plan additional tests, and we'll continue until we make contact. We used the simpler but very efficient NEC 24 GHz units. We consider the NEC 24 GHz unit to pack quite a punch, considering its low cost.

24 GHz Waveguide Transition

Kent WA5VJB has come up with the construction of a 24 GHz WR-24 waveguide transition (see Figure 2). Kent is constructing a 24 GHz SSB system using a 10 GHz IF and a 13 GHz injection frequency to a mixer for generating SSB on 24 GHz. I will provide the construction details in a future column. Thanks to Kent and the North Texas Microwave Society. Be sure to check out their bi-monthly newsletter *The Feedpoint* (contact Wes Atchison, Rt. 4, Box 565, Sanger TX 76266).

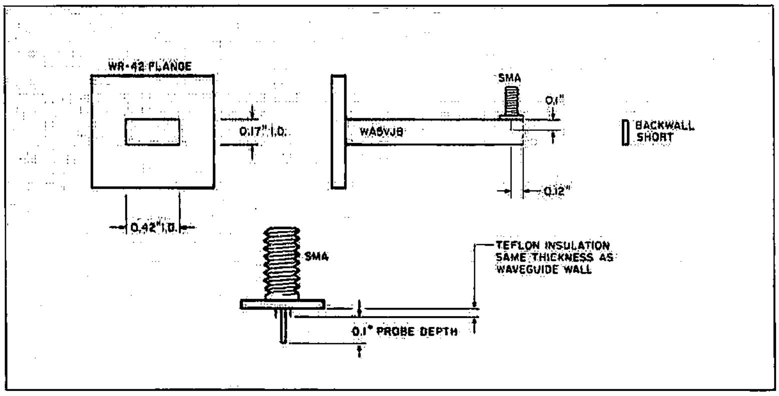

Figure 2.

General VHF/UHF News

News from the *Midwest VHF Report* is that several stations took advantage of the aurora during the VHF Sweepstakes. WA9O worked 10 states on 2 meter SSB. N/0LL added 20k contest points to his score by making 39 contacts on 220 MHz and 1296 MHz. Rich K9DZE had a SUPER Aurora Saturday and Sunday. He picked up 10 new grids on 2 meters and 12 on 6 meters.

In Michigan, Bruce Rittenhouse N8IRW and Ken Hendrickson N8DGN have formed the West Michigan Microwave Group. They're out to shatter some myths about microwave operation:

MYTH #1 *It's only good for line-of-sight operation.* Not true! The same tropospheric scattering that makes QSOs of up to 500 kilometers possible on 2 meters (on a dead band), is also present on 10 GHz. Band openings occur on microwave frequencies, too. From the *RSGB VHF/UHF Manual*, 4th Edition: "There was a famous occasion in 1798 when the whole of the French coast from Calais to Dieppe became visible one afternoon from the cliffs near Hastings. Effects such as these are even more pronounced at radio frequencies."

MYTH #2 *It's expensive.* N8IRW and N8DGN are busy showing their home-brew transceiver, which cost about $50 to build and works very well, at swap meets and clubs.

MYTH #3 *You have to be a Ph.D. to work microwave.* You don't have to be an RF expert to build a microwave station. There are several active amateurs in this country on various microwave bands who are not even technicians or engineers.

I will be happy to answer any questions related to microwave operation. For a prompt reply, send an SASE to the above address. Best 73s.

Number 35 on your Feedback card

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

Amateur Radio has always been international in the sense that political boundaries, obviously, have never been able to stop radio waves in midair. Today, however, international broadcasting (governmental, commercial, and also private—amateur) is purposeful to a degree not ever known before; and the worldwide communications of "tomorrow," meaning in immediate future months and then all future years, is going to boggle our minds.

Just as an example: As Wayne W2NSD/1 said in an interview for an article a few months back, ". . . in 10 or 15 years we'll [be using] a little laptop keyboard for writing messages and [having] them delivered anywhere in the world in seconds, for pennies."

It is May 17, 1989, as we write these words for the August "73 International," and they are to remind you that on this date the 166 member nations of the ITU (the International Telecommunications Union) celebrated the 21st World Telecommunications Day. A year from this date they will be celebrating the 22nd World Telecommunications Day.

*We think it would be a great idea if Amateur Radio clubs around the world scheduled some events in honor of internationalism, little events or big ones, on or around May 17, 1990—**and let us know about them!** If you have sent us your plans (and pictures, if you can) **before the end of February, 1990**, we will be able to make the May 1990 issue internationally special! See the feature item of this month's column, below, **"Communications At The Crossroads."***

Roundup

Albania. ***EXCLUSIVE!*** **A DXpedition to ZA—the rarest of the rare!** Not since the 1971 trip by Martti Laine OH2BH has an Albanian trip been in the news. This one, proposed for September of this year by Peter Vekinis EI4GV (19 rue Le Titien, 1040 Brussels, Belgium; Tel: 02/ 736–3690; Fax 03/ 271–1715; The Source ID: IP2006), is still being worked on—contact him for details and watch for more information.

Austria/China.[•] (Roundup items marked [•] are from *Sweden Calling DX-ers*, the publication of Radio Sweden.) A delegation from Radio Austria International went to China on the invitation of Radio Beijing and the Chinese government to discuss a possible exchange of broadcasting hours and relay cooperation.

Australia.[•] We may get more details from VK3AJU, but a flash for now: The new Radio Australia transmitter at Brandon, Queensland, had two days of use before along came Tropical Cyclone Aivu and its 200-kilometer winds and put it out of business. The storm equalled the ferocity of 1974's Cyclone Tracy which wiped out Darwin, and reportedly killed 4 and injured many.

Costa Rica.[•] For the third year in a row, the Swedish DX Federation has named Radio Impacto of Costa Rica "QSL Station of the Year." This shortwave station has answered reception reports even though it has not intentionally been broadcasting for listeners abroad. Its programming has been political and aimed at neighboring Nicaragua.

Switzerland. The First World Book and Audiovisual Fair on Telecommunications and Electronic Media will take place in Geneva between October 3 and 8. It will be associated with ITU-COM 89, the first World Electronic Media Symposium and Exhibition. Further information from: *Book Fair '89 Secretariat, ITU, PR Division, Place des Nations, CH–1211 Geneve 20, Switzerland.*

Calendar for August

1—Army Day, China; National Holiday, Switzerland (2nd for El Salvador, 9th for Singapore)
3—Memorial Day, Cyprus; Independence Day, Niger (6th for Bolivia, 10th for Ecuador, 11th for Chad, 14th for Pakistan, 15th for India, 17th for Indonesia, 19th for Afghanistan, 25th for Uruguay)
4—Freedom Day, Guyana; National Day, Jamaica and Burkina Faso (15th for Congo and Korea, 20th for Morocco, 31st for Malaysia and the Republic of Trinidad and Tobago)
7—Battle of Boyaca, Colombia; Bank Holiday, Ireland
12—Queen's Birthday, Thailand
13—Women's Day, Tunisia
16—Restoration Day, Dominican Republic
20—Constitution Day, Hungary
23—Liberation Day, Romania (27th for Hong Kong)
24—National Flag Day, Liberia
28—Summer Bank Holiday, Great Britain
29—Heroes Day, Philippines
30—Victory Day, Turkey

CANARY ISLANDS
(Spain)

Woodson Gannaway N5KVB/EA
Apartado 11
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(Las Palmas de Gran Canaria)
Islas Canarias
Spain

It feels time to send in something from the Canaries again. Today is El Dia de los Trabajadores (Labor Day, I think, or May Day, as it is now called in China, France, Germany, and the USSR) and so nobody is working.

We live in a small town on the NW side of the island of Grand Canary; the town is Santa Maria de Guia. It's famous for its cheese and as a long time supplier of the best of Canary knives. The acknowledged best of the few men still forging blades for these distinctive knives is in his sixties, and I work in his shop every morning to learn. In the afternoons and evenings, I teach my English classes.

I get on the radio whenever I can; up to now, usually CW above 21.100 on 15 meters, but I'm starting to branch out a little more. The old Drake covers 80–10 and I've dipoles for 40–20–15 so far. For the present I have to stay on my long, narrow balcony, so I'm somewhat limited. Still, I get over to the US now and then with a 559 signal (the balcony is open to the E, not to the W). Although no trouble to boom into Yugoslavia, it's a challenge to go elsewhere.

Woodson Gannaway N5KVB/EA, Canary Islands, Spain.

Radio Club Cultural Gran Canaria (EA8RCT) in Las Palmas is proceeding with remodeling its meeting room and adding additional space outside. The two areas will be joined by large sliding doors to allow use of both areas together during the marvelous summer evenings when a lot of hams gather there.

(A friend there also asked me to mention their continued wholehearted participation in all contests, with all QSL cards replied to.)

The Club de los Radioaficianados del Noroeste (Amateur Radio Club of the Northwest) came up with and executed an idea a few years back—around 1982, perhaps. Maybe somebody can send me a photocopy of the QSL card? I wanted to find a photo of this so bad, but just haven't been able to turn one up! Drat! [*Do keep trying—we'll publish it!!—CCC*]

Members of the club, based in Guia and Gaidar, spawned and brought to fruition the idea to make a walk around the perimeter of this island with radio equipment—the radios to be carried by a burro. They fashioned a rack to balance the radios and batteries, with an extension out over the burro's tail to carry the antenna.

They secured the special callsign EA8VIB (EA8 Vuelta de la Isla con Burro—Trip Around the Island With a Burro—although in English VIB could also be "Very Important Burro") and operated on five bands.

So, for five days they walked around this scenic island with the burro carrying the gear and batteries and acting as a station platform. A doctor went with

them—a good thing because there were numerous foot problems (for the people, not the burro). They camped out at night and recharged the batteries.

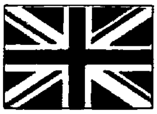
When they completed the circuit and were walking back into Guia, it was a festival day, so they got a rousing welcome with lots of people cheering and church bells ringing!

Eddie V. Manalo DU1UJ, founder of the AsiaNet Group, and presently QRV on 14.111 MHz, operating DU1BBS packet bulletin board mailbox.

Lynn V. Manalo DU1AUJ, founder of the Asian YL-Net, on HF RTTY, ARQ, packet and SSB.

Art Lising DU1AUL, QRV on packet VHF, 144.090 MHz.

David Tan 9M2DT, on 14.111 MHz, operating 9M2BBS packet mailbox.



GREAT BRITAIN

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Hawley Hill
Camberley GU17-9JQ
England

Regular readers of this column will know that the 50-metre band became available to UK amateurs only quite recently. So major openings still capture the attention of us all; indeed, the events of the last weekend of February have been described as the biggest 50-metre event since the band became available.

Things began to look promising on the Wednesday when LU5EZT maritime mobile was worked 5 and 3 each way from GØDAZ in Worcester (pronounced *Wustah* for intending tourists!). By Saturday, things really began to hot up with the VS6SIX beacon being heard just before 0900; this was quickly followed by what is believed to be the first G to VS6 QSO on 50 MHz, when G4UPS worked VS6UP with strong signals and full readibility in both directions. G stations on the South Coast are also believed to have worked VS6TC, WA, and GU.

Barely was the excitement of VS6 contacts in control when a number of Japanese stations were heard 5 x 9 at about 0915. Indeed, JA4MBM was still being heard 5 x 9 at 1100. Unfortunately, despite the strength of the JA signals, there are no reports of two-way contacts with G stations on this day, although G3XBY is reported to have worked "several" Japanese stations.

Back to Saturday when, at the time the JA stations were first being heard, ZS6BMS was worked 599 both ways by GØDAZ, who also is believed to have worked T77C (San Marino) for another probable first.

Perhaps the biggest pileup occurred when J52US in Guinea-Bissau was working G stations with good reports both ways. Other exotic DX was heard in the shape of TR8CA (Gabon), ZS4TA, and numerous VS6s added to the pileup. Less exotic, but nevertheless welcome, DX was apparent from North America when the opening swung in that direction by Monday. Amongst those stations heard were K2QIE, VE1YX, and K2GAC.

Other examples of this opening included the 10-metre beacon, VK2RSY, being heard 5 and 5 and a whole clutch of exotica heard (but not worked) including stations from DU1, Z23, CT1, 9HI, HC5, and HC1. The world's QSL managers will no doubt be busy in the next few months!

If the 50 MHz opening was not enough, there was a major auroral event beginning on Monday, March 13th and opening up the whole of Europe to 144 MHz stations. Indeed, so strong was the aurora in Scotland that stations were reporting 5 and 9 signals from Sweden regardless of the direction in which they pointed their beams.

Stations as far north as the Midlands (say, between Birmingham and Manchester) reported good contacts with the Channel Islands, Germany (East and West), Scandinavia, Yugoslavia, Czechoslovakia, Austria, Poland, Hungary, and Italy. Stations in the east of England had numerous contacts with Russian stations, including those in UQ2, UC2, UR2, and UB5.

The same event giving all this lovely DX was responsible for a blackout denying communications to the base camp of the ill-fated attempt by Sir Ranulph Fiennes to walk to the North Pole. Ten-metre contact was eventually established with the base camp by the London Control Centre. Despite the temperature of minus 40 degrees Celsius (!) the base camp reported everyone to be in good spirits.

PHILIPPINES

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AsiaNet Packet Network
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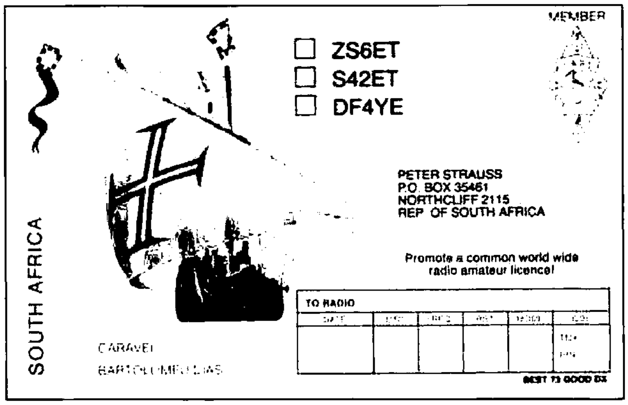
Republic of the Philippines

[*We were happy to receive this report from DU1AUJ; in fact, we are always happy to receive reports from citizens of all countries outside the USA, particularly when there has been a long silence from a Hambassador. Lynn is thought to be the first Asian woman to go on HF packet and is the only XYL station on AMTQR and RTTY. She is active on 20 and 15 meters, and is active daily beginning around 1300 UTC; presently she handles the Asia YL-Net on 21.188 every Sunday at 0700 UTC.—CCC*]

The Republic of the Philippines has been a center for world news since the days of what they called "The Peaceful Revolution." With all the changes in the government, the progress of amateur radio was not hampered. Activities, particularly in packet related matters, grew, and success followed success.

On July 1, 1986, Eddie DU1UJ with Kohjin JR1EDE founded the AsiaNet Packet Network. For several months they were the only stations handling traffic all throughout Asia, but later were joined by AX4BBS (Brian VK4AHD) and Gil VK6AGC. This expanded the operations quite a bit, as did the next additions, 9M2BBS (David 9M2DT) and YB1BBS-Kinta. With all this cooperation, they later decided to move to 14.111 MHz from 14.107 MHz to have a good link with the USA. This made it possible to hook into SkipNet. And with the efforts that these fellow amateurs are making, the world is helped to meet one common objective: to promote friendship and brotherhood.

Locally, on VHF, there are many packet bulletin board systems operating. In the Metropolitan Manila area there is DU1BBS operated by Eddie DU1UJ, Art DU1AUL, Glenn DU1CUP, Mon



DU1BJD, Paul DU1POL, Eddie DU1EAG, and Pete DU1PJS. In the south of the Philippines there is Den DU9EW, and in the north, Mo DU3MF.

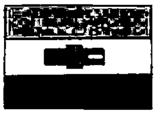
With all these BBSs in town, DU1UJ decided to put up a digipeater in Tagaytay, utilizing a KPC-4 and ICOM 28H and 48A. The vast activities of this digipeater is proven effective, for it covers most of the Luzon area—the biggest of the three main Philippines islands.

In the Mindanao area, DU1POL and DU9BC have established a digipeater at Mt. Kitanlad which is supposed to cover the island of Mindanao; and right now these fellow hams are negotiating for the establishment of a third digipeater, in the Visayas region—the island between Luzon and Mindanao.

With these and continuing efforts, it won't be long, we hope, before all of the 7,100 islands which make up the Philippines are linked together into one, through the wonders of amateur radio.

The rare DX country, Marion Island, is on the air again, with Peter Sykora ZS6PT using the call ZS8MI. Amateur Radio Spectrum on RSA—the Voice of South Africa—will regularly give news of this operation, weekly, as follows (times approximate): **SATURDAYS**—1345 **UTC** to India, the Far East—21590 and 17755 kHz; Southern Africa—9585 kHz; 1445 **UTC** to Middle East, Eastern Europe—25790 and 17755 kHz; Southern Africa—11925 kHz; UK and Europe—21590 kHz; USA and Canada—21670 kHz; 1845 **UTC** to UK and Europe—21535 and 17795 kHz; 1945 **UTC** to West Africa—21590 kHz; to Southern Africa—7295 kHz; to East Africa and Middle East—17795 kHz; **SUNDAYS** 0245 UTC to USA and Canada—9815, 9580, and 11730 kHz.

Peter will often be heard around 1830 UTC on 14145 kHz—a good time to learn of the next few days' activities. Please do not break in until he has finished his traffic with his QSL manager. QSL address: ZS6PT, PO Box 1387, Vanderbijlpark 1800, South Africa (or through the bureau). If you expect a QSL direct, include suitable postage in US$ or IRCs.



SOUTH AFRICA

Peter Strauss ZS6ET
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Republic of South Africa

News Items

The South African license authority will consider applications for short-term permits from amateurs from any country holding CEPT Class I- or II-compatible licenses—except Novice, since there is no compatible license grade here.

The South Africa administration has concluded bilateral agreements with 15 countries (see box).

BILATERAL AGREEMENTS, SOUTH AFRICA AND:

Bophuthatswana
Botswana
Chile
Ciskei
W. Germany (Incl. W. Berlin)
Great Britain
Israel
Portugal
SW Africa/Namibia
Swaziland
Switzerland
Transkei
Venda
USA
Zimbabwe

COMMUNICATIONS AT THE CROSSROADS

When Prince Henry of Prussia tried to telegraph a thank-you message to President Theodore Roosevelt at the turn of the century, it was refused because his ship's equipment was incompatible with that of the coastal receiving station. And when the *Titanic* was sinking, radio distress signals to a passing ship went unheeded as its radio operator slept through the night.

This would not happen today. International standards ensure world linkages of compatible and interference-free networks which allow an unfettered flow of signals across national borders.

International cooperation was not always necessary. When Samuel Morse sent the first public telegraph message in 1844, no one dreamed the breakthrough would actually alter life as it was then. Early telegrams went from city to city, always within national boundaries. But as communications spread from country to country, the need for global international legislation prompted 20 countries to meet in 1865. They drew up the first International Telegraph Convention, the precursor of today's equivalent of a charter for the ITU, the International Telecommunication Union.

The 20 founding States of the ITU in 1865 were: The Austro-Hungarian Empire, the Grand Duchy of Baden, the French Empire, the Free City of Hamburg, the Empire of all the Russias, the Swiss Confederation, the Ottoman Empire, and the Kingdoms of Bavaria, Belgium, Denmark, Spain, the Hellenes, Hanover, Italy, the Netherlands, Portugal and the Algarve, Prussia, Saxony, Sweden and Norway, and Wurttemberg.

Today, the Union's 166 members meet regularly, countries talk to each other instantaneously, and airwaves circle the globe, but there are new challenges as the 21st century approaches. The speed and complexity with which people now communicate requires unprecedented cooperation and international agreements involving rules for sharing costs when calls transmit through more than one country, harmonized switching and transmission principles to interconnect a variety of national networks, and regulation of frequencies to allow for satellite systems and broadcasting and mobile services for maritime, aeronautical, and land communications to function throughout the world.

"The telecommunications industry has changed drastically. There are more players now, with traditional users and providers constantly exchanging places as they mix and match equipment, networks, services, and information to provide each other with new services and business opportunities. . .The success of world finance and global trading depends not just on a few rules, but on the movement of goods, on financial services, and especially on telecommunications to support all this activity."

Richard E. Butler, ITU Secretary-General

Last May, the 13th Plenipotentiary Conference in Nice, France, examined a series of crucial issues with respect to future challenges. Economic zones will have to be considered, such as the European Community in 1992, and new cooperative relationships within North America and Asia. The committee called for more results, more quickly. As one example, it called for a new policy to cut paper flow. In 1988 60 kilopages of documents were produced for activities of the International T & T Consultative Committee (CCITT) alone! And more pages pertained to others of the 438 experts (from a roster of 2,500) who undertook 591 field missions in 1988. Last year US$31 million was spent on projects in developing countries, financed mostly by the United Nations Development Programme and Funds-in-Trust.

NEVER SAY DIE

Continued from page 8

To be honest about it, what we have is a government policy of screwing small business. Think about it. Both the administration and Congress are like willows, bending whatever way lobbyists blow. And lobbyists are paid by big business, not by small. Thus small business has little control over the government—little say—little power. The government moves the way money pushes it, and big business has the millions to be heard—clearly—wiping out the faint background noise from small business which has only thousands to spend.

Myopia—Doing Away with Tomorrow

Worse, and you've been reading a lot about this lately (if you've been reading), big business is totally in the grip of the quarterly report, so its goals are invariably short-range. There's no planting of seeds possible, just reaping as if there is no tomorrow, which takes care of eliminating tomorrow just fine. So we've avoided automation and updating our old factories; avoided technology's benefits.

How far are you willing to let all this go? When are you going to lift your head and take a look at what's going on? Are you going to let America sink into a miasma like the horrible mess Britain is in? It wasn't very long ago it used to be called *Great* Britain.

Britain got into deep trouble earlier than we because the lowered transportation and communications costs hit them sooner, being so close to the Continent. Their unions, abetted by labor governments, refused to face the reality of global competition. Now they have millions of people who are out of work and may never work again. They have a new generation which has never worked and may never work—no jobs because the unions forced their industries to lose money until they closed. They fought automation and lost jobs.

If I'm right, what can we do to cope with the changes? Can we hold back the ocean by stubbornly refusing to come to grips with the ways technology has changed the world? We see just that mentality at work with Morse Code in amateur radio. We see it in unions which fight reality. We see it in weak government officials who blow with the winds from union PAC funds and lobbyist money from big corporations. We see it in a Congress whose priorities are (1) getting re-elected, (2) getting the money needed to buy re-election, and (8,275) doing what's best for the country.

The Strength of Our Country

Once we recognize that small business is the real strength of our country—and I mean small manufacturing businesses much more than service businesses—we can start working to build this strength. But won't the economies of scale always allow big business to produce lower cost products than a small business? Only in a few industries where tooling costs are enormous. Oddly enough, the bureaucracy which inevitably builds up in a big business, keeps it from being able to compete head-to-head with the almost always more efficiently run small businesses. So big business has to pull every dirty trick it can to wipe out pesky small businesses.

If we're going to have strong small businesses, we have to have people to run them and work for them. This comes down to education. Again, unless you're just off the turnip truck, you know that every recent study has rubbed our nose in how poor our education is compared to many other countries—in how much it has gone down in quality in the last fifty years. We're not going to be able to compete with Korea, Singapore, Japan, Taiwan and Europe unless our educational system is at least as good as theirs.

The worst part of this is that we've been protected against much of the potential competition the world could offer. The beyond-description poor management of African countries has kept them from being players so far. The same in India, Malaysia and Indonesia have also protected us. Imagine what could happen if China and Russia ever notice that communism has never worked anywhere in the world it's been tried, and stop hobbling their industries with government planning!

Using Technology in Education

We do have the potential to come out on top of all this in the long run. We have the potential to turn things around and stop going the British route. That opportunity lies in being the first country in the world to modernize our education—to come to grips with technology and use it for our benefit, instead of fighting it.

Our teachers brag about how they have defeated every high-tech teaching aid which has been offered them. They brag about killing off the use of audio cassettes, film strips, films, video and now, computers. They're not going to lose their jobs just because there are some more efficient ways of teaching.

Did you see the recent articles in news magazines about how our kids are learning less and less? We amateurs are so used to talking with the world that we know pretty much where things are, but in a recent test 14% of the kids couldn't name the country just to the north of us—and 37% didn't know what country was to the south.

I was amazed a few years ago when I was driving a high school senior babysitter home. I mentioned that I'd just had a contact with King Hussein on my radio. She'd never heard of him. Hmm, he's the king of Jordan. Nope, never heard of Jordan. It's right next to Israel. Never heard of Israel, either. That's a senior here in Peterborough.

No wonder we're having trouble getting kids interested in talking with other countries—they don't even know they're there. That isn't the fault of the kids, it's OUR fault for being so lazy about our schools and letting them fail so miserably in their responsibilities. We permit less than 25% of our kids to get any science education in high school.

Our Novice exam calls for no more electronic knowledge than the average high school student should have learned. Instead, the exam is almost an insurmountable obstacle for many kids. If you don't think all this comes right down to you, just look at what's been happening with the Asian students in our schools. They're running away with all the honors and getting first crack at our better colleges just because their parents insist on their working hard.

Your grandparents or great-grandparents, when they came here, worked their asses off to make things better for their kids. And they really pushed their kids to work hard. Then something went wrong at home. Can we honestly blame it on television or Dr. Spock? The blame is irrelevant, the question is, what can we do about all this?

Training Kids and Dogs

If you, as a parent or grandparent, make it your business to see that kids are pressured to learn—to excel—this will, in turn, put pressure on the teachers and schools to do better. We can force them to turn to technology to help them teach, to be more productive. And that's what technology does, it makes for more productivity. Getting kids interested in learning isn't easy. You won't get far with punishment, so you have to outsmart them, if possible. You have to make it worthwhile to excel.

I've a couple of greyhounds. Training them is much like training kids, they'll do anything you want as long as you convince them it's what they want to do. If you try to force a greyhound to do something, it'll just put on a martyred look and lie down. Punishment is completely useless. Only guile will win. Same with kids.

But amateur radio today is even more relevant than it's ever been. It's a key to helping youngsters have a major advantage in life over those without this boost. The future is technology, so the more our kids can learn about communications, electronics and computers, the better it's going to be for them and for our country. Learning geography won't hurt either.

Here we are with electronic and communications technology growing almost faster than we can follow it. We have the potential to use amateur radio as a way to invent and pioneer new communications systems and to inspire kids to go for high tech careers. It was our amateur radio repeaters which spawned cellular radio. Now we have everything we need in technology to develop a high speed automated message-handling system using HF, UHF, microwaves and satellites which could allow any of us to reach any other licensed amateur in the world in seconds. Or are we going to continue to try to jam our 1930s code requirement down unwilling young throats, alienating the kids we need so desperately to get our hobby going again?

Recognizing and Keeping Up with Changes

In the '20s we heard the cries of "Spark Forever." In the '50s it was "AM Forever." Now it's "CW Forever." Will someone lift a few rocks and let some light in? I got a good laugh at a recent talk I gave. I asked how many in my audience were still using CW. A bunch of hands went up. Hmmm. Then I asked how many were using computers to copy it—same hands. Give me a break!

The fact is my four-pound $399 Model 100 computer can copy code faster and better than the world's best Morse op. You say my batteries may fail? Nope, they're rechargeable. You say the nuclear winter may make it so dark I can't see the LCDs? Gee, that's a big problem—maybe I'd better brush up on my code so I'll be able to help handle the hundreds of millions of messages a few hundred hams will be called upon to pass.

I've had a good deal of success in life by keeping track of the changes technology is making for us, and pushing in the direction of the change instead of fighting it. But, you know, I can't think of any time I haven't had an "old guard" fighting both me and the changes.

I read about sideband in the '50s, tried it, and believed it was our future for voice communications. So as editor of *CQ* and then *73* I pushed hard—was fought tooth and nail by AMers. In the '60s I saw solid state as the future—again was fought angrily by tubes-forever hams. Was it as recently as 1969 that the technical editor of *QST* wrote an editorial saying hams would always be

tube people—that transistors would never be of much value to hams?

In the early '70s I saw FM and repeaters as a big future for us—and was fought every inch of the way by old guard hams, with no help from any other ham magazine.

In the mid '70s I saw the just-invented microcomputer as the future. Indeed, I wrote at the time that I believed the microcomputer would eventually spawn an industry as large as the automobile industry—to guffaws and letters beefing about my publishing articles on computers in *73*. So I started Byte and a few other computer magazines. Did well.

When I read about compact discs, I again saw the future . . . and started *Digital Audio* magazine. It's done well, too. I turned out to be right again. It's the fastest growing consumer electronic industry in history.

So here I am, keeping track of change—looking to see how it's affecting our future . . . and I'm worried. The lack of young hams is hurting amateur radio as a hobby—and it's helping bring about a serious drop in the number of American engineers, technicians and scientists.

NO, a resurgence of young hams alone isn't going to save America. But without 'em we're going to have a lot harder time with the other problems...like our decayed educational system, the high cost of college, and a tax system which is helping to drive manufacturing overseas. I need your help with the ham end. I'm working on RPI to provide a proven way to get college costs cut in less than half—and Jordan to develop a new and much more productive educational system for kids.

Updating Ham Radio

Changing the ham requirements from a demonstrated Morse Code skill to a tougher technical entrance exam is just one step I believe we need to take to keep up with technology. I don't expect that's going to uncork any large scale youngster interest in hamming by itself—it'll just help us make more sense to them once we get their interest. We still need radio clubs in schools and a campaign to get kids interested in the excitement hamming has to offer.

Yes, I know all about kids not being excited about hamming because they see international television programs every day. Baloney! The fun of personally talking with people anywhere in the world—or anywhere around town—beats the hell out of CB, CompuServe, Playnet and TV. It does for you, doesn't it? So why do you think you are so different?

How have you been handling change? Fighting it or embracing it?

The Time Warp

I've some letters from old-time hams who are furious that a copy of *73* now costs $2.95 and a subscription $20. Good grief, they say, it used to be 37¢ and $3 a year! And it used to be a lot fatter. Come on here, what are you doing to us?

Apparently the Carter years' trauma has wiped out all recall of a most memorable inflation, leaving no lasting impression on these OTs. Look, we've had almost thirty years of inflation since I started *73* back in 1960, and we haven't had any deflation. Haven't you codgers noticed that *everything* costs more?

Eisenhower said it clearly when he promised the government would tax us in dollars for social security and pay us back with dollarettes. So today we're spending Monopoly money when we go to the store. A nickel subway ride is a buck. A nickel cone is over a buck. That 37¢ copy of *73* should cost at least $7.50 a copy today.

Well, what looked like a fat magazine at 128 pages in 1960 now looks like a pamphlet because scientists have invented new, lighter, and much thinner paper. Maybe you haven't noticed the way magazine pages stick together now. They're down to about one RCH in thickness.

Ham Day

Ham Radio Day—the first Saturday in December—is alive and growing. How about your club mounting a major PR offensive next December. You've got lots of time to plan for it, unless you do as usual and put it off until late November.

The idea is to set up a ham station in a public area—like a mall—and do two things. First you want to be able to hook into the national traffic network to deliver worthless messages—probably using packet, which seems the way the NTS is going these days. Second, and much more important, you want to have an exhibit which will show people who never heard of amateur radio some of the things we do which are fun—so you can interest passer's by in the hobby. Let's see if we can drum up some interest, particularly with kids. This means the exhibit (s) have to be fun oriented and not the usual eclectic snob stuff which tells people this is too complicated for them to ever understand and also too expensive.

The Evolution of *73*

In 1960 we used 60-pound per ream of a standard paper size, the most popular magazine stock. As paper prices went through the roof, the paper companies had to make lighter and lighter paper, from 50-pound to 48, down to 45, 42 and now most magazines use 40-pound! This makes the same number of pages much thinner and lighter, and keeps the cost of both paper and postage down.

Old-timers probably haven't noticed that the magazine size has increased by 73%, from the old 6" x 9" size to 8.5" x 11". That's 1.73 times as much page space. That makes a 116-page issue today equivalent to a 200-pager in the old size.

That's not all. Again, in order to keep the cover and subscription prices low, all magazines have had to increase the percentage of advertising pages per issue. In the early days of *73* we ran around 35% ads. Today a magazine is in trouble if it runs much less than 50% advertising.

So, if you don't mind paying $7.50 per copy or $60 a year for a subscription, adjusted for inflation, we can go back to the small, heavier-weight magazines with fewer ads. Please let me know.

Amateur radio is a whole bunch of hobbies, so I try to cover as many of them as I can in *73*. Construction projects (more than the other three magazines combined), technical articles to keep you up with the state of the art, antennas, DXing (our DX Dynasty Award is the most difficult there is), packet, RTTY, SSTV, weather satellites, OSCAR, repeaters, UHF, contests and certificates, FCC actions, club activities, and ham politics. In my editorials I tell it as I see it, even when this means attacking some deeply held ham religious beliefs, such as the sanctity of the Morse Code test.

Anyway, I think we've done well to keep the *73* price as low as we have. The equivalent price today is more like a 15¢ cover price in 1960. Hey, if you would like to pay 37¢ again, adjusted for inflation, I can give you a 200 page magazine every month. I love the idea, but do you really like the idea well enough to pay $60 a year for a subscription? ■

HAM HELP

Number 36 on your Feedback card

Your Bulletin Board

We are happy to provide Ham Help listings free, on a space available basis. Please type or neatly print your request on a full-size sheet of paper. Use upper and lower case letters—not all capitals. Be sure to print numbers carefully. A "1" and "l"; "7" and "T" or "l" and other numbers and letters can be easily misread when they are not printed clearly. "U" and "V" can also be confused. Thank you for your cooperation.

I need an operating manual and/or schematic for a Heathkit HR-10. I will pay all associated costs for a copy, or I will copy and return the original. Thank you.

Warnant Patrick
736 Raymond
St. Jean, Quebec
CANADA J3B 4YG

I need instruction manual and schematic for Southcom SC-102 Thunderbird transceiver. Also need 12 volt P/S for same. Will pay.

Dick Beckham W7FVM
1989 Hibiscus Circle
St. George UT 84770

I need a copy of the July 1988 article in *Hands On Electronics* magazine about the "mini-receiver" using the Radio Shack TDA7000 IC. Will pay postage and copying costs. Thanks.

Scott A. Littfin NØEDV
921 Raton Court
Manitowoc WI 54220

UPDATES

AMPIRE and PROCOMM/DIGITREX

The May 1989 review of the Ampire 146-OS did not include a phone number. It is (612) 425-7709.

Please correct the phone number in the April 1989 review of the Wideband Supercone antenna. It is (805) 497-2397.

Uniden Mod

Refer to the Uniden mod correction in June "QRX." Change the referenced resistor R39 to R93.

Double Oops

We finally have it right this time—Al Misunas' call is WA2RLO, not WB2RLO as listed in the March 1989 QRX column, page 14, or the May 1989 QRX column under "Errata," page 10.

Siliconix Makes Power FETs

Refer to the sidebar "What Is MOS-Power?" in the article "220 MHz Amp" in the June '89 issue, on page 40. Ed Oxner KB6QF from Siliconix wrote to correct us. Although Siliconix sold the RF power MOSFET product line to M/A-COM PHI, Inc., in 1983, they still produce a large range of power FETs, as outlined in their MOSPOWER catalog. ■

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PROPAGATION

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Jim Gray W1XU
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Late Summer Forecast

August will be typical of the summer months, with moderate solar activity. Expect DX on 10 meters, and around-the-clock DX on 20 meters. Twelve and 17 meters will be somewhere in between.

Forty meters will provide DX from sunset to dawn, and 30 meters will be a good nighttime band. Good daytime short skip will be available on all bands.

A very active sun will cause geomagnetic field disturbances at times, and there will be frequent solar flares. Check the daily charts for expected Good (G), Fair (F), and Poor (P) days.

Day-to-day conditions follow below, as shown on the calendar. ■

EASTERN UNITED STATES TO:

GMT:	00	02	04	05	08	10	12	14	16	18	20	22
ALASKA	15	—	—	—	—	20	20	20	—	—	—	15
ARGENTINA	15	20	20	20	—	—	—	—	—	10	10	10
AUSTRALIA	—	—	—	20	20	20	15	15	15	—	—	—
CANAL ZONE	15	15	20	20	20	—	20	20	15	10	10	10
ENGLAND	20	20	40	—	—	20	—	15	15	20	20	20
HAWAII	15	15	15	20	20	40	20	—	—	—	15	10
INDIA	15	20	—	—	20	20		—	—	—	—	—
JAPAN	15	—		—	—	20	20	20	—	—	—	15
MEXICO	15	15	20	20	20	—	20	20	15	10	10	10
PHILIPPINES	20	15	20	20	—	—	20	—	—	—	—	—
PUERTO RICO	15	15	20	20	20	—	20	20	15	10	10	10
SOUTH AFRICA	—	—	—	20	20	—	—	15	15	15	20	20
U.S.S.R.	20	20	20	20	—	—	20	—	—	15	15	20
WEST COAST	15	15	80	80	80	—	20	20	20	20	15	15

CENTRAL UNITED STATES TO:

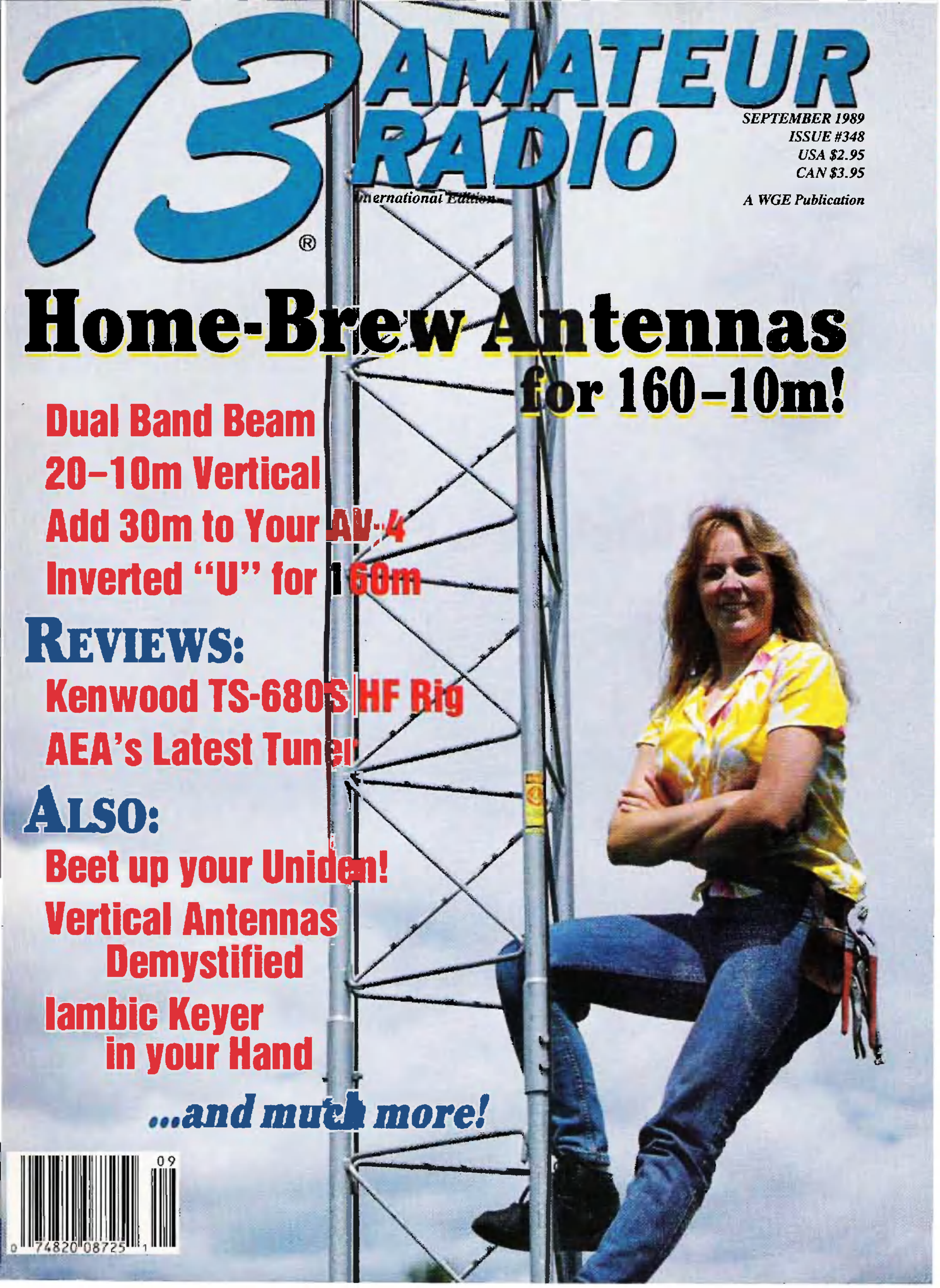
GMT:	00	02	04	05	08	10	12	14	16	18	20	22
ALASKA	—	15	15	—	—	20	20	20	20	—	—	—
ARGENTINA	15	15	20	20	—	—	—	—	—	10	10	10
AUSTRALIA	15	15	15	20	20	20	20	20	—	—	—	—
CANAL ZONE	15	15	20	20	20	20	20	20	20	15	10	10
ENGLAND	20	20	20	40	—	—	—	—	—	—	—	15
HAWAII	10	15	15	20	20	20	20	20	—	—	—	—
INDIA	20	20	—	—	—	—	20	—	—	—	—	—
JAPAN	—	15	15	—	—	20	20	20	20	—	—	—
MEXICO	15	15	20	20	20	20	20	20	20	15	10	10
PHILIPPINES	20	20	15	20	—	—	—	—	—	—	—	20
PUERTO RICO	15	15	20	20	20	20	20	20	20	15	10	10
SOUTH AFRICA	—	—	40	20	—	—	—	—	15	20	20	—
U.S.S.R.	20	20	20	—	—	—	—	—	—	15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	05	08	10	12	14	16	18	20	22
ALASKA	15	15	20	20	20	20	20	20	15	20	—	15
ARGENTINA	10	15	15	20	20	—	20	20	—	—	—	15
AUSTRALIA	10	10	15	15	20	20	40	40	20	—	—	—
CANAL ZONE	15	15	20	20	20	40	80	—	—	15	15	15
ENGLAND	15	20	20	20	—	—	—	20	15	15	—	15
HAWAII	15	15	15	20	20	40	40	20	—	—	15	10
INDIA	—	—	15	—	—	—	20	20	20	15	—	—
JAPAN	15	15	—	20	20	20	40	20	20	20	—	15
MEXICO	15	15	20	20	20	40	80	—	—	15	15	15
PHILIPPINES	—	—	15	—	—	20	20	20	15	15	—	—
PUERTO RICO	15	15	20	20	20	40	80	—	—	15	15	15
SOUTH AFRICA	—	—	—	20	20	—	—	20	20	15	—	—
U.S.S.R.	20	20	20	20	20	—	—	—	—	—	—	—
EAST COAST			80	80	80	—	20	20	20	20	15	15

AUGUST

SUN	MON	TUE	WED	THU	FRI	SAT
		1 F	2 F-P	3 F-G	4 G	5 G
6 G	7 G	8 G	9 G	10 G	11 G	12 G
13 G	14 G	15 G	16 G-F	17 F	18 F-P	19 P
20 P	21 P-F	22 F-G	23 G	24 G	25 G-F	26 F
27 F-P	28 P	29 P-F	30 F-G	31 F-G		



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73 AMATEUR RADIO

SEPTEMBER 1989 — Issue # 348

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FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 33. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

Cover by Marilyn Moran; photo by Frank Cordelle
Tully Londner ascends the *73* tower to do a little work on the Sommer beam.

See page 33 to learn more about Kelly N6PNY.

Welcome, Newcomers!

A Special Kind of Circuit

Antennas range from a single length of wire to a complex array of metal tubing. Antennas come in many shapes and sizes, but the three most common kinds of ham antennas are the dipole, the vertical, and the yagi beam.

A circuit is called an antenna when it radiates (transmits) into the atmosphere radio frequency (RF) energy that passes through it and/or to intercepts (receives) electromagnetic waves.

Changing the physical length of the elements of an antenna is one way to change its **resonant frequency.** The antenna radiates and receives most efficiently at the resonant frequency. The longer the antenna elements, the lower the resonant frequency; the shorter the elements, the higher the frequency.

You can also tune (that is, change the resonant frequency of) your antenna by including a "trap," which consists of a capacitor and a coil, or only a coil. Using a trap, you change the **electrical length** of your antenna while keeping its physical length the same.

A horizontal antenna, such as a dipole, has horizontal **polarization.** Antennas whose elements are parallel to the earth tend to radiate horizontally. The yagi, the most common type of beam, may have horizontal, vertical, or slantwise polarization, depending on how it is rotated about its **boom** axis. A vertical antenna has vertical polarization.

Feedlines, Impedance, and SWR

The **feedline** connects the antenna to the transceiver. **Coax** is the most commonly used feedline. You can bend it, bury it, and run it next to metal objects. It's also weather-resistant and easy to get. Most importantly, its **impedance** closely matches that of the feedpoint of most antennas. **Ladder-line**, a parallel conductor feedline, is also popular because it can handle high power even with a significant **impedance** mismatch between transmitter and antenna, and typically conveys most of the RF energy going into it from the transmitter to the antenna feedpoint. We call this "low-loss." You can't bend ladder-line, or run it near metal objects, however, and it can't be connected to most transmitters without an **impedance matching circuit.**

The impedance of coax is 52Ω or 75Ω, while the impedance of parallel conductors runs 300Ω and higher. If you don't match the impedance of your antenna with the impedance of your transmitter, too much RF energy reflects back to your transmitter instead of being radiated. This can seriously damage your transmitter.

An SWR meter reading of 1:1 means that the most efficient transfer of power exists between the transmitter and the antenna. Generally, an SWR of more than 2:1 is too high.

HF Antennas

The dipole is inexpensive, easy to make, and adaptable. All you need is two equal lengths of wire cut the right length for the operating frequency, a center insulator, and a feedline with the appropriate connector.

The horizontal, inverted-V, and sloper dipoles are the most widely used ham antennas. However, the dipole requires at least two supports as high above the ground as possible, and a lot of space. For example, a **half-wave dipole** antenna for 80 meters would be 126 feet long; each segment would be 63 feet. You can shorten the dipole by adding a coil to each element.

Vertical antennas are also popular because they usually need only one support point, require little space, and sometimes outperform horizontal antennas on long distance contacts. They sometimes require long **radials**, however, which can demand a lot more real estate.

Beam antennas, such as the yagi, are commonly used for 40m and higher frequency band operation. The elements would be too long to be practical for 80 and 160 meter operation. A 3-element yagi has a director, a driven element, and a reflector, all attached crosswise to a boom. Increasing the number of directors increases the directivity and gain of the beam. Directional beam antennas have two main advantages: The directivity reduces the strength of signals from directions other than the one you point the antenna at, and they radiate your signals more where you want them to go.

Antenna Experimentation

Amateur radio operators have always been avid antenna experimenters. Besides the fun of innovation, many hams are motivated by practical considerations, such as legal and space restrictions, special environmental demands, money, and materials on hand.

In *73*, we feature unique home-brew antenna systems. Antenna experimentation is going strong, and it looks like it will continue for a long time to come. Not all the data is in yet. . . . Eds. 73

Glossary

Coax, coaxial cable A feedline that consists of a center conductor surrounded by insulation, that in turn is surrounded by a wire braid called the shield.

Boom The non-radiating piece of an antenna that directly supports the antenna elements. On a yagi, the elements cross the boom at 90° angles.

Electrical length The electrical length of an antenna is measured by the time it takes for a charge to travel to the end of the antenna and back in one cycle of the applied frequency. The electrical length and the physical length may be different. Besides length, other factors, such as nearby objects and insulating materials, affect the resonant frequency of an antenna.

Element That portion of the antenna that does the bulk of the RF radiation and coupling with incoming RF energy.

Feedline A cable that conducts RF energy between your transceiver and your antenna. Feedlines should radiate as little RF energy as possible. Where the feedline and antenna meet is called the *feedpoint.* Coax, twin lead, and ladder line are common feedlines (also called transmission lines).

Frequency The number of cycles of a radio wave that passes a given point in a given amount of time. The more cycles per second, the higher the frequency, and the shorter the wavelength. Frequency is usually given in *Hertz.* One Hertz is one cycle per second.

Half-wave dipole A horizontal antenna made by connecting two equal lengths of wire to the feedline at the center, where each length is a quarter wavelength of the operating frequency.

HF High Frequency. A section of the electromagnetic spectrum from 3–30 Megahertz (MHz). The 80–10 meter amateur bands are HF bands. Worldwide amateur communications occur most often on these bands.

Impedance The opposition a circuit offers to the flow of current. Impedance is measured in ohms, symbolized by the Greek letter Ω.

Impedance matching circuit A circuit that matches the input impedance of the antenna to the output impedance of the transmitter. The transmatch and balun are impedance matching devices.

Ladder line A twin-lead type of feedline constructed of bare wire with plastic spacers to keep the wire separate and parallel.

Polarization The orientation of the electromagnetic field of the antenna in relation to the earth. The electrical field of a wave is generally parallel with the active element(s) of the antenna.

Radials Lengths of wire that extend from the base of a vertical antenna in a radial pattern, to improve the efficiency of the antenna and lower its angle of radiation.

Radiation The act of RF energy leaving an antenna system and entering another medium, such as the atmosphere.

Resonant frequency The frequency at which the antenna performs best; that is, where it radiates the most efficiently and optimally receives such RF energy.

RF Abbreviation for "radio frequency energy." The RF portion of the electromagnetic spectrum ranges from about 20 kHz to 30 GHz, which is divided into eight frequency bands, from VLF (very low frequency) to EHF (extremely high frequency).

SWR The ratio of RF energy the antenna system radiates versus the RF energy the antenna system reflects back to the transmitter.

Transceiver A transmitter/receiver pair, usually contained in one box.

Twin lead A feedline that has two parallel conductors separated by a strip of insulation.

Wavelength The distance between one cycle peak and the next of an RF wave. For example, on the 80 meter band, the peak-to-peak distance is 80 meters. The higher the frequency, the less distance it will travel in one cycle.

Number 2 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

The Killer Blankets

Wouldn't you know, it turns out that it isn't the microwaves or high frequencies that are killing people as much as it's good old 60 cycles. Since you probably don't read the *New Yorker* magazine, you missed the fascinating series they published on the subject. You'll be reading about it everywhere from now on and seeing it on TV. This is going to outclass the Alar, radon and Chilian grape scares. Newsweek gave it a page (7/10 issue, page 71).

In case you prefer to go right to the bottom line and avoid reading the gory details, it turns out that people who live near power line distribution points or high tension wires are getting clobbered. Cancer, birth defects, miscarriages and so on. Other clobberees are people working around video terminals and those using electric blankets. Well, you can bet I unplugged my blanket and removed the cord even before I finished reading the series.

No, this isn't another case of cold fusion or room-temperature superconductivity. The *New Yorker* doesn't suck into technology scare stories easily. The series names the scientists and how much the power companies paid them to cover up the mess that's been discovered and is now unraveling.

It turns out it's low frequency magnetic fields which raise hell with living cells, much more than radio waves. Radio, if it's strong enough, cooks 'em. Low frequencies upset the ability of cells to function and replicate correctly. Worse, experiments have shown that the magnetic fields which affect cells can be far weaker than ever imagined! We're talking below one milligauss!

It's the 60 Hz vertical deflection coil in video terminals which does the dirty work. You sure don't want to work within a couple feet of those for long. The magnetic field from your electric blanket will gradually bollix your cells. Just living near a pole pig transformer can greatly elevate leukemia and cancer in you and your family.

What can we do besides panic? Well, panic is a good first step. The next step is to get busy and get your kids and grandchildren law degrees as quickly as you can so they can get in on the feeding frenzy of lawsuits the power companies are going to have over this. Yep, those SOBs know they are killing us. Just like the cigarette companies know they are, too. Well, how about Congress? Money talks with them, not lives.

So let's go to step three. We hams, being acknowledged electrical experts (haw, if they only knew how little the tens of thousands of Dick Bash graduates actually know about electricity or radio!), can help lead the world away from the destruction Nicola Tesla and his monster, alternating current, have wrought. It turns out Edison was right, DC was the way to go!

Now, how are we going to go about saving the world? Well, the devil is 60 Hz magnetic fields, so what we need to do is come up with some inexpensive gaussmeters which will measure magnetic fields so we can sweep our homes and businesses for dangerous levels. You thought radon was awful? AC seems to be killing even more people than cigarettes, and thousands of times more than radon.

So let's get our little ham hands busy designing and building gaussmeters. I'll publish your designs in *73* so we can get started helping our neighbors avoid further death and birth defects. I'm sure you'll do this philanthropic work out of the goodness of your heart and it will never even occur to you to go into business and charge for saving lives.

Hmm, you say, if this is such a danger, how come our media, which is always anxious to jump on even the slightest of scare bandwagons, has been so oddly silent? Newspapers and news magazines these days are totally dependent upon video terminals for writing, editing and page makeup. Worse, their video display terminals are often side by side, giving their staffs the worst possible barrage of these magnetic fields.

How about the TV reporters? And scare people into turning off their color TV sets? No way!

So we've had a conspiracy of silence by the media, fed by the fear of lawsuits by employees and the high cost of magnetically shielding their VDTs.

I'm sure glad I've been using laptops with LCD screens for the last ten years. And don't say I haven't been trying to get you to do the same.

The Paul Brodeur series, which is due out this fall in book form by Simon & Schuster, is called *Currents of Death: Power Lines, Computer Terminals and the Attempts to Cover Up Their Threat to Your Health.*

When you consider that life exists only because we have a replicating DNA molecule, which in turn is made up of arrays of hexagonal benzene-type rings, each a sub-microscopic electromagnetic circuit, it's not a big step to see how outside magnetic fields could have a profound effect on this very delicate replicating process.

Continued on page 68

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock, NH 03449, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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QRX . . .

EDITED BY BRYAN HASTINGS NS1B

Home-Brew IV

Thanks to the *hundreds* of authors who responded with construction articles for the Home-Brew IV contest! At the end of July, the four-ham committee spent hours carefully evaluating each and every entry. Look for the winning three articles in the November issue.

Radiation Hazard Seminar

The first-ever Doctors' Panel on Radiation Hazards and Amateur Radio will take place the weekend of August 25–27 at the ARRL Southwestern Division Convention, Airport Hilton Hotel in Los Angeles. The effect of non-ionizing radiation on the human body is a growing concern.

The event will be hosted by Dr. Wayne Overbeck N6NB, 1980 Radio Amateur of the Year. The panel will consists of four very prominent MDs. The first is Dr. W. Ross Adey K6UI, the world's premier researcher on the effects of electromagnetic radiation on the communication between living cells. The second is Dr. Samuel Milham, one of the world's most widely quoted epidemiologists, who found that people who work in electrical/electronic occupations have about double the average mortality rate from lymphatic cancer and leukemia.

The third is Dr. Ivan Shulman WC2S, a cancer surgeon who will discuss measures amateurs can take to minimize their exposure to electromagnetic radiation without abandoning their hobby. Dr. David Rodman KN2M, an ophthalmologist who has conducted extensive field measurements of both RF and 60-Hz magnetic fields surrounding amateur radio stations, will discuss his findings and methods of modeling E-M radiation hazards with computer software.

Never before has a panel with this much expertise on the hazards of E-M radiation been assembled anywhere but at a professional conference for specialists in this exotic field. Those interested in attending should make reservations by writing to: Hamcon '89, PO Box 18201, Encino CA 91416-8201. Admission price to the convention and all technical sessions is $12.

Dayscholar Winners

Ted Holmes N8ZM, President of the Dayton Amateur Radio Association, announced the four youngsters who are winners of the DARA 1989 Scholarships. They are Laurie Sandell N2FSO of Larchmont, New York, Lesley Walker N4FTJ of Cullman Alabama, Cynthia Gauthier N5KLQ of Pineville, Louisiana, and Jon Kidder KB8FQL of Wilmington, Ohio. Kidder will receive the newly created Robert F. Zimmerman Memorial Scholarship. Zimmerman, a long-time supporter of DARA and the scholarship program, passed away just before the 1989 Hamvention.

Each winner receives $1,000 to apply toward tuition at a school of their choice. These awards are an annual event, and the program is open to any licensed amateur graduating from high school in the year the award is given. There are no restrictions in the student's course of study or his/her license class.

Applications for the 1990 scholarship program will be accepted after January 1, 1990. For further information, write to the DARA Scholarship Committee, 317 Ernst Avenue, Dayton OH 45405.

Generations are bridged through ham education. These proud sixth graders from Payson Arizona show off their totally home-brew deluxe crystal sets, containing nearly a dozen components. Their Elmers are William "Pete" Pedersen W7KTK and Jim Gray W1XU, 73's own Propagation columnist.

Kenwood BBS

More and more electronic bulletin board systems are serving amateur radio. The Kenwood Communications and Test Equipment Group BBS is now available to any ham with a computer and modem. System parameters are 300/1200/2400 baud, 8 bits, 1 stop bit, and no parity. The BBS features amateur information, news, and programs. Access it at (213) 761-8284, 5 PM–8 AM PST Monday through Friday and all weekend.

220 Marches On

On 9 July, radio amateurs marched in various cities across the US to protest the FCC action that resulted in the reallocation of 220–222 MHz to commercial interests. The march was surprisingly successful in some cities, in light of the fact that US hams have little history of protest activities.

Perhaps the biggest success story was in Omaha, Nebraska, where over 50 people turned out for the march. John Gebuhr WBØCMC noted that all of the media—radio, television, and print—covered the Omaha event. In Cincinnati, Paul Oldaker NS8I reported that the march was also a success, with about 50 participants and some media coverage. About 20 hams and other supporters turned out for the Chicago protest.

Curiously enough, protest activity fizzled in a state that stands to suffer the most from the spectrum loss. Marches in Los Angeles and San Francisco never got off the ground, due to political conflict and lack of organization.

Thanks to the protesters in marches in other cities who took part in this 9 July event but don't appear by name in this report.

FCC Fees

The House Energy and Commerce Committee voted 13 July to levy licensing fees on ham radio operators and satellite-launching companies, and to increase fees on communications businesses. The action aims to reduce the federal budget deficit by $50 million.

By this bill, existing licensing fees charged by the FCC will go up an average of 12.6 percent and 17 communications areas that were exempted will have fees instituted, ranging from $30 for an amateur radio license to $70,000 for a permit to launch a satellite. FCC fines, unchanged since 1934, will also increase.

About a third of the anticipated $50 million will come from private radio operations such as rural radio, national paging services, offshore, mobile and amateur radio, and cellular phones. At this time, both the General Mobile Radio Service and Class D Citizens Radio are exempted.

Thanx

Thanks to *Westlink Report, ARRL Gateway, Television Broadcast Magazine,* and K9XI for providing items for this month's QRX. Keep your ham radio-related news items and photos rolling in to *73 Magazine,* WGE Center, Forest Rd., Hancock, NH 03449, Attn: QRX. You may also submit text to the /QRX SIG on the the 73 BBS, (603) 525-4438, 300/1200 baud, 8 data bits, no parity, and one stop bit.

Build a 30 Meter Trap

Modify your Cushcraft AV-4 or AV-5 for 30 meters.

by Gregory McIntire KE0UV

Many new rigs include the WARC bands, and many older rigs are easily enough modified for these new bands. Why are they then still relatively unused? Because many pre-WARC HF antennas won't adequately load on these new bands!

My Cushcraft AV-5 trap vertical worked just fine on five bands, but it wouldn't even HEAR stations on 30 meters, let alone tune up properly for transmitting. My solution was to build a 30 meter trap.

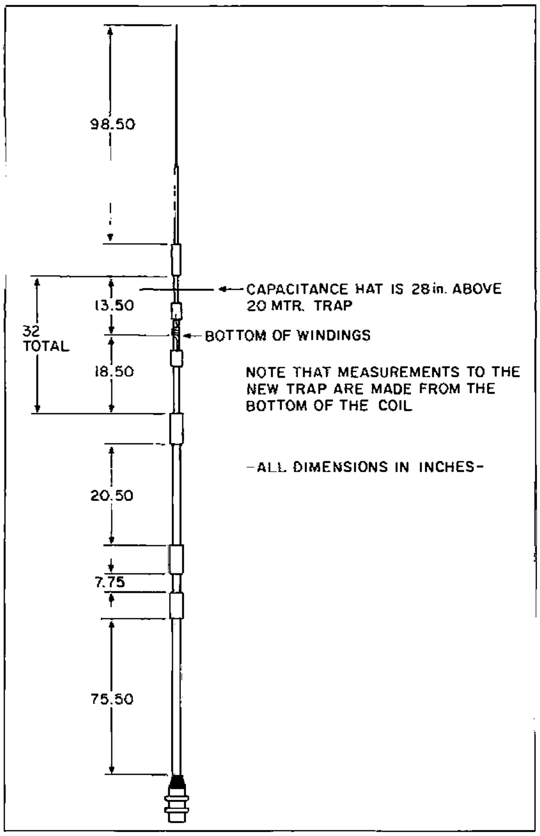


Figure 1. Cushcraft AV-5 trap vertical showing the inserted home-brew 30 meter trap.

Hard-Earned Lessons

I had, in the past, tried to build an entire four-band trap vertical. The results were discouraging, but I learned a lot:

- A trap MUST be resonant at the frequency of interest.
- The components comprising the trap must be of adequate rating.
- The trap must be positioned in the antenna in the proper place. Be sure to resonate the trap properly.

This time I tried two different coil form materials: PVC plastic tubing, and wood. They worked about the same, but I chose the wood because of its strength and heat resistance. According to my reference materials, wood also has a dielectric constant as favorable as PVC.

For the coil, I tried #16, #14, and #12 wire. The number #16 wire got too warm at 100 watts of transmitted power. The #14 seemed satisfactory, but I chose the #12 for added margin, and it worked flawlessly.

For the capacitor, I first tried a 500 volt mica cap. It lasted about two or three seconds! I didn't have any higher rated caps, so I finally tried a length of coax cable. The ARRL *Handbook*, as well as various other sources, gives the capacitance per foot of various different types of coax. I chose Belden "Mini 8" (stamped as 9258) because of its relatively high capacitance per foot, and its voltage and current handling capabilities (100W) were adequate for my purposes.

A trap for this vertical has to present an impedance of 100–300Ω. For this, you need to know the basic formulas: $X_C = 1/2\pi fC$, and $X_L = 2\pi fL$, where X_C is the capacitive reactance, C is capacitance, X_L is the inductive reactance, L is inductance, and f is frequency. A little work with the calculator revealed that a coil of 3.37 μH and a capacitor of 73.3 pF gives an impedance of 214Ω and resonance at 10.125 MHz.

The exact dimensions of the coil wound on a 1" wood dowel form are 20.5 turns of wire, "spread wound" to a length of 2.7 inches. A 37" length of Mini 8 coax provides the proper capacitance. But, the simplest way to resonate the coil is to first wind the coil on the form, solder on a "longer than needed" piece of coax, then carefully snip off the other end of the coax, a little at a time, until you reach resonance.

Construction Details

To build the trap, first get a length of 1" wood dowel from your local lumber or building supply store. You will also need about 80 inches of #12 solid copper wire, plus two pieces of 1" i.d. (inside diameter) aluminum or copper tubing, available at a plumbing supplier or hardware store, for covering on the ends of the wood form. Be sure to pick up a couple of hose clamps and some screws. Most instructions recommend coil dope to cover the coil, but I used a product called Varathane™. It is an "all weather" clear plastic finish applied with a brush. It did not change the resonant frequency of the trap at all. You could also use regular vinyl electrical tape to hold the coil windings in place.

See Figure 2. Cut a 9.5" piece of the wood dowel rod. The 1" tubing will slide over the ends of the dowel. You will probably have to wrap a layer of thin aluminum or galvanized sheet metal around the ends of the wood dowel as "one inch" means a different thing to a plumber than it does to a carpenter. You could cut a section out of a tin can to provide this material.

Next, put a layer of epoxy glue on the last two inches of each end of the wood dowel. Wrap the appropriate amount of tin around the 2" end of the wood. Now add another coating of epoxy, then slip the 4" pieces of tubing onto the ends of the dowel. Slide the tubing on over just the first two inches. Now roll the assembly on a table to insure that it is straight. You may need to wiggle and twist it a little.

After the epoxy has set, drill a hole in each piece of tubing about ½ inch from its inside end. (Later, you'll secure the coil to the tubing at this spot with a screw.) Cut four slots

into the tubing on the outside ends, about 1.5 inches deep. Measure in about 1.25 inches from the tubing ends (towards the center of the wood form) and drill a small hole for a screw to secure the two ends of the windings. Finally, apply a coat of Varathane or shellac to the wood.

To wind the wire around the wood form, you must first straighten the wire. The wire MUST be entirely kink free! I had to strip the insulation off of the length of #12 wire, but this is fairly easy to do. Clamp one end of the wire in a vise (or tie it around a sturdy fixed object) and slice the insulation for the full length of the wire. The covering will peel off easily. Then, keeping the wire in the vise, use a piece of tubing (the coil form tubing will work for this) to straighten the wire. Holding the tubing in both hands, starting at the secured end of the wire, wind the wire a quarter turn around the tubing, then walk backwards pulling the wire around the tubing with your thumbs. Hold the wire against the tubing so that you get a "drag." You may have to do this a couple of times to get the wire straight, but, if done properly, this procedure really straightens the kinks out of the wire.

Next, secure one end of the straightened wire to one of the inner screws on the wood form. Leave a "tail" long enough to later secure to the screw in the tubing section. Now, with the other end of the wire still attached to a leg of the XYL's china cabinet (or vise), hold the form in both hands, draw the wire taut, and slowly rotate the coil form, winding the wire as you go. You must keep a strong "pull" on the wire to keep the windings tight. Space the windings such that the space in between windings is just slightly less than the diameter of the wire. After 20 revolutions, you should be near the other securing screw. Secure the wire to it. Trim both ends of the wire so that they can be wrapped around and secured to the screws in the tubing, but don't attach them until the trap has been resonated.

Strip off about two inches of the outer insulating jacket of the piece of coax. Slip the inner conductor through the braid so as to have a piece of coax with a 2″ inner con ductor lead and a 2″ outer conductor lead. Or, just unravel the braid to get the same effect. Now, measure and cut these coax leads so that they can be soldered to the ends of the coil. Slip a piece of insulating material (heat shrink tubing, etc.) over the braid, then solder these leads to the ends of the coil. The trap is now ready to resonate.

Resonating

A grid-dip meter would really be the ticket here, but this poor OM doesn't have one. I used an RF generator connected to a simple RF probe plugged into an analog voltmeter. Connect a small inductor of 10 µH to 100 µH between the RF probe and the RF generator. Tune the generator and you should get a voltage reading on the meter. If not, select the proper voltage setting until you do. Adjust the frequency of the generator to 10.125 MHz with the help of your HF receiver.

Note that, as the generator is tuned higher in frequency, the measured RF voltage will probably decrease. This is because the impedance of the small inductor increases with higher frequency. Don't worry—for our purpose, this is not a problem.

Now place the trap very close to the little inductor (or dip meter). Tune the generator (or dip meter) until you detect a dip in the

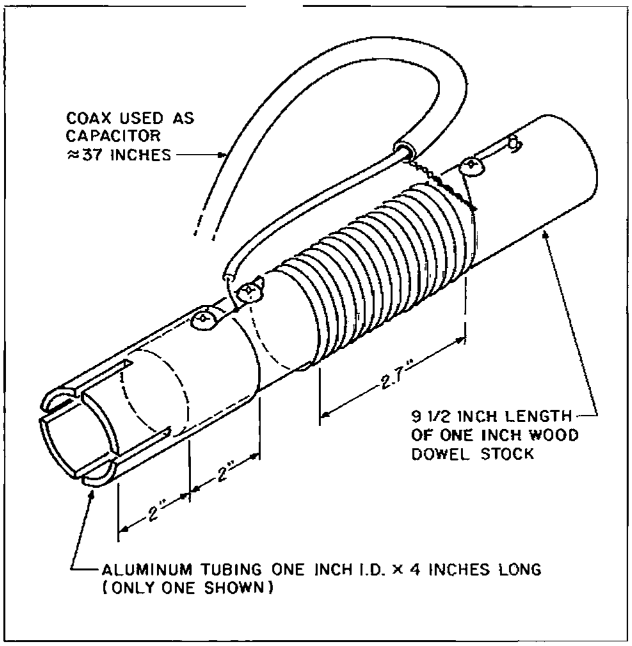


Figure 2. Details of the 30m trap construction.

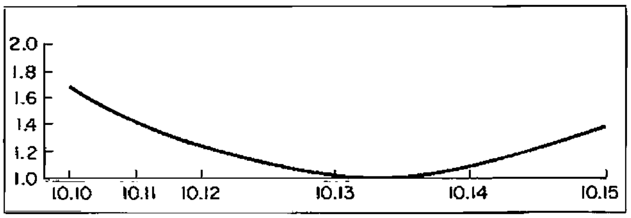


Figure 3. AV-5 SWR curve on 30m after the installation of the 30m trap.

meter movement. When you find the resonant frequency of the trap, move the trap away from the coil (dip meter) to verify that it is indeed the trap that is causing the dip. If you used Belden Mini 8 coax for the capacitor, the approximate length will be 37 inches. At any rate, start with a length of coax that is a few inches longer. Hopefully, you will have a dip that is lower than 10.125 MHz. Simply snip off small amounts of the coax and remeasure the dip until it occurs at 10.125 MHz.

Also, after finding the preliminary resonance, position the trap as far away from the "dip meter" as possible, while still allowing you to detect the dip. This assures minimum interaction between circuits. If you snip too much coax you can move the coil winding slightly to achieve the same effect (resonance). Remember, though, that the coil windings must not touch each other!

Now you can give the coil windings a coat of coil dope, other suitable varnish, or even plain electrical tape. (It is important that the windings stay put and do not slip.) Attach the coil ends to the tubing. I found that if you don't follow this procedure, resonant frequency will be about 1.4 percent lower, and this is unacceptable.

The next step is to seal the unconnected end of the coax, coil it up three turns or so, and secure it to the trap somewhere above the coil windings. I devised a housing or cover for the coil out of a piece of thinwall 2" PVC tubing and the top half of a round plastic bottle. A little bathtub caulk and tape make a weather-tight "rain cap." I then taped the coax to this housing. The coax should be in its approximate position (as opposed to just hanging off the end of the workbench) during the resonating procedure above.

Installing the Trap

Get a length of 1" o.d. (outside diameter) aluminum tubing. Hint: A lot of aluminum lawn chairs use 1" o.d. tubing. (You could use the existing section D tubing of the Cushcraft antenna, but it would be nice to not mutilate it. You might want to sell the antenna at a later date.) Cut two pieces of this tubing to lengths that will let you position the new trap as shown in Figure 1, allowing for some adjustment. Secure the trap with hose clamps. Use the same procedure as described in the antenna's manual for tuning the new trap.

> ***"A trap for this vertical has to present an impedance of 100–300Ω."***

The 10, 15 and 20 meter bands will change little if any. The 40 and 80 meter sections will be shortened slightly, but after you retune them their bandwidths should be just about the same as before installation of the 30 meter trap.

All the dimensions in the figures are for the lowest SWR in the lower parts of the respective bands (CW, RTTY, AMTOR and Packet), but if you want 30 meter capability, you probably are already a CW man or a digital nut like myself. If the trap is resonated and positioned properly, it should produce an SWR of 1:1 at 10.125 MHz, and about 1.5:1 at the band edges. Using the components described, the trap performs perfectly using 100 watts maximum average power.

Final Hints

Construction technique is not critical, but the trap MUST resonate at the correct frequency or you will have a hard time finding a proper position for it in the antenna. (I know: I tried.) Weather-seal the assembly to suit your environment. The measurements for locating the new trap may differ somewhat for the AV-4 antenna, but the trap construction should be the same.

See you on 30m!

by Paul Grupp KA1LR

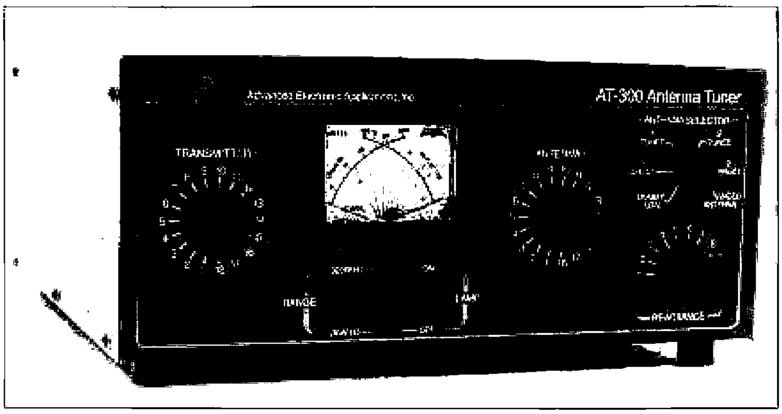
AEA AT-300

High quality T-network HF antenna tuner.

Advanced Electronic Applications, Inc.
PO Box C-2160
Lynnwood WA 98036
Tel. (206) 775-7373
Price Class: $250

AEA may have built their reputation on digital electronics, but the design and construction of their new AT-300 antenna tuner shows that they've learned a thing or two about the analog world of RF along the way.

The AT-300 includes just about everything we've come to expect in an antenna tuner, with a few unusual twists. On the front panel are TRANSMITTER, ANTENNA, and REACTANCE controls for the tuner. The TRANSMITTER and ANTENNA controls are 18-position switches, and the REACTANCE control is continously variable.



Also on the front panel are a cross-needle SWR/power meter, a 30/300 watt power range switch, a lamp switch for the meter lights, and an antenna selector switch that lets you choose between two coax-fed antennas, a dummy load, and a balanced antenna. The coax-fed antennas have two switch positions each, to place the tuner into, and take out of, the antenna system.

On the rear panel are coax connectors for the transmitter, antennas one and two and dummy load. A post and wing nut are provided for ground, and posts mounted in ceramic insulators are provided for the balanced antenna. 12V power for the front panel lamp can be connected to the 2.1 mm jack.

> ***"It uses a lowpass T-network, with two multitapped air-wound inductors and a big variable capacitor."***

Inside the AT-300

The AT-300 is housed in a tight RF-proof metal box, with plenty of screws to keep it that way. At 6" x 12.75" x 14.75", it is one of the biggest 300 watt tuners available today, but the size is necessary to keep the Q on the inductors high, thereby reducing loss at the antenna tuner.

Inside, the layout and wiring is neat and efficient. Even though the AT-300 is only rated at 300 watts, its components are as hefty as those found in some tuners rated at over a kilowatt. This provides an extra margin of safety when operating into a severely mismatched load.

The design of the AT-300 is simple. It uses a lowpass T-network, with two multitapped air-wound inductors and a big variable capacitor. This design, while hardly unique, is a departure from most other tuners on the market, which generally use a pi-network configuration. However, the T-network is a reasonable choice; it provides good harmonic suppression, and since two of the three controls are stepped switches, settings are easily repeatable for fast band changes.

Like most tuners, the network is unbalanced. However, a large ferrite-core transformer is included inside the box for feeding balanced-line antennas.

Some hams might prefer to see roller inductors in place of the switched multitapped inductors found in the AT-300. However, in practice, the 18 position switches provided ample range of adjustment.

The AT-300 in Action

I used the AT-300 with a balanced long-wire antenna for a couple of weeks, and uncovered no problems or deficiencies. I was pleased to discover that the AT-300's meter gave very similar readings to the built-in meter in my Kenwood TS-940S over a variety of power ranges and on all bands. The meters in many tuners are marginal at best, but if you own an AT-300, there is no good reason to buy another SWR/power meter.

The owner's manual is excellent, and provides lots of applications information to keep inexperienced tuner users out of trouble. A schematic is also included with the tuner, in case you ever need to repair or modify it on your own.

My only complaint is that the tuning range is limited to 3.5 to 30 MHz. They didn't include 160 meters.

Conclusions

The AT-300 enters an already crowded field of competitors; good tuners are available from several manufacturers. Nevertheless, the AT-300's features and quality make it worthy of serious consideration for any amateur who doesn't own (anddoesn't plan to own) an amplifier. Its built-in antenna switching, easy-to-read SWR meter, and balanced antenna capabilities combine to make a very useful package. Now, if we can just get AEA to build a larger version for those of us who do run higher power! 73

Unique 12 and 17 Meter Dual-Band Beam

Build a high gain beam for these two new WARC bands.

by Robert E. Bloom W6YUY

Have you noticed that there are many monoband beam articles published, but almost none for multi-banders, even for the non-WARC bands? There's the feeling that hamdom has no choice but to buy a multiband beam. I figured, though, that for $500 dollars and up for the commercial products of comparable quality and gain, you could build a multibander for up to a quarter of the price, and learn a lot in the bargain!

This article shows you how to do this. The antenna project here is a unique 12 and 17 meter interspaced dual-band array. This puts you on two great bands. 17 meters has the best of both worlds (so far)—it has propagation characteristics very similar to that most popular DX band, 20 meters, and yet is still only very moderately used. 12 meters is also a very mildly used band, and is open at least as often as 10 meters—which is quite often these days.

Impressive Specs

The forward gain of this beam approaches 8 dBd and has a front-to-back ratio of 25 dB. The single radiator element uses a pair of 12 meter high-"Q" traps and a pair of stacked gamma matching units which accommodate a single 50Ω coaxial cable transmission line. Construction is simple and sturdy.

I suggest this beam for a club project not only because of its fine performance, but also because you save money when you buy aluminum tubing in quantity. A source for the tubing is *Metal & Cable Corporation, 2170 East Aurora Road, POB 117, Twinsburg OH 44087.*

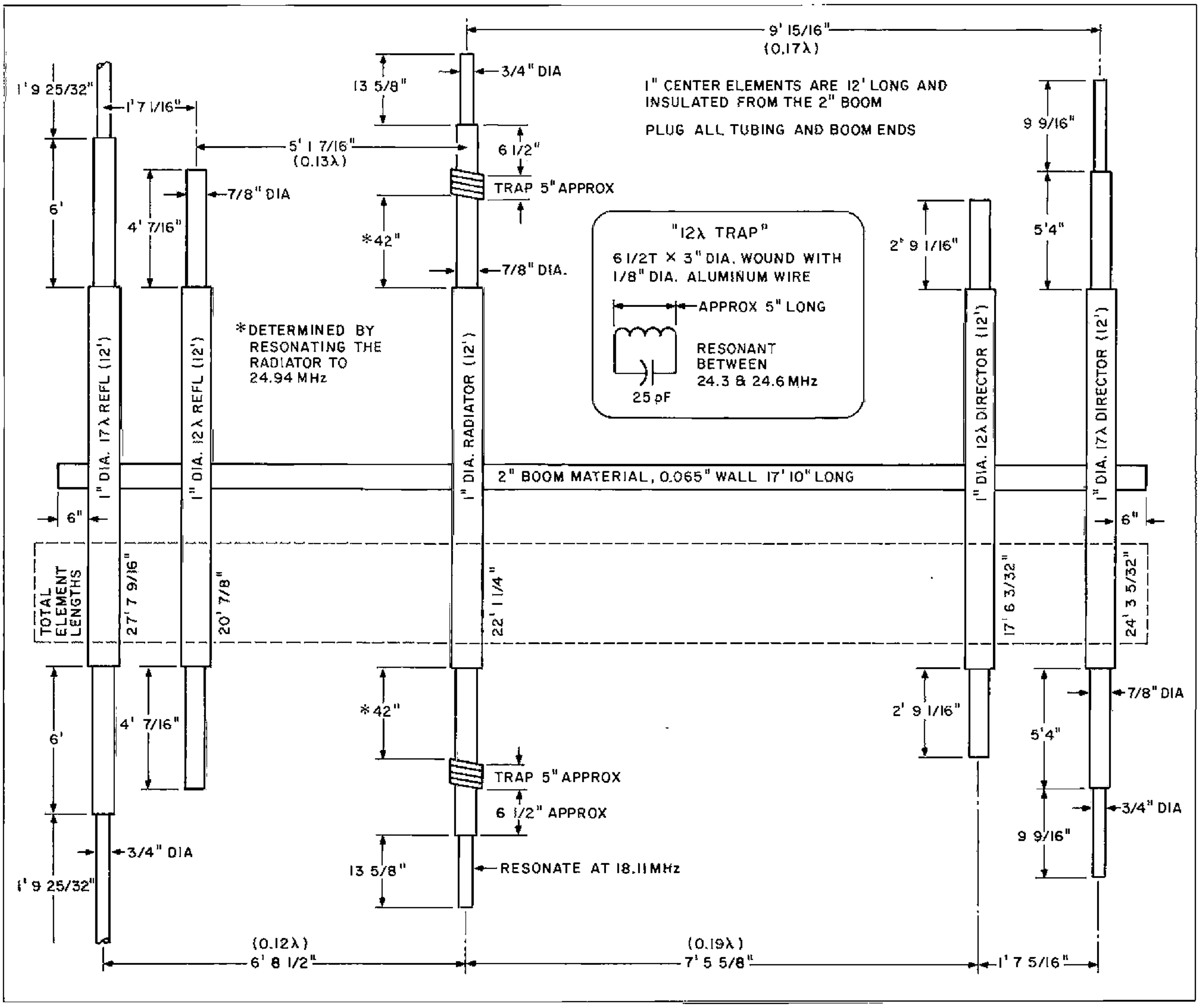


Figure 1. Plan with dimensions for the dual-band 17 and 12 meter beam antenna.

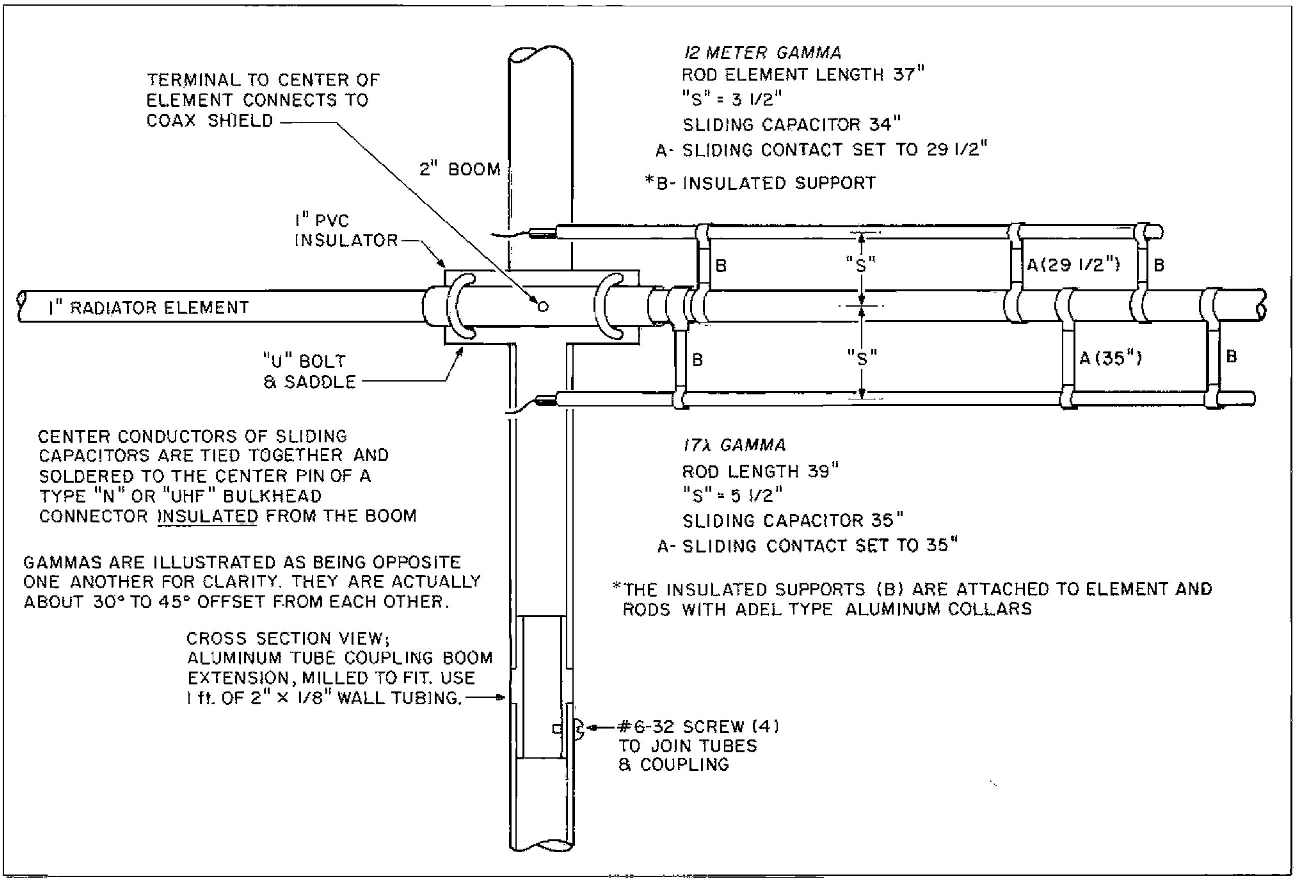


Figure 2. Stacked gamma matching devices.

This unit has a boom length of 17 feet plus, and is actually equivalent to a new commercial product with a boom length of 19 feet. You may wonder how it's possible for an array to perform as well as one with a longer boom length. The element spacing is similar to that of the 19 footer, but the trick here is that I use only a single radiator for the two bands; the 19-footer uses two, one for each band. The second radiator has to be separated from the other element, which demands more boom space without adding an iota of gain.

Parallel Gamma Matches

Feeding a beam with multiple gamma matches is not new, but little has been written on the subject. I found mention of them only in *The New Beam Antenna Handbook*, by William Orr W6SAI and Stuart Cowan W2LX. This book is one of the best ham antenna publications available.

If you follow my dimensions on both the beam and trap construction, and make the initial SWR adjustments to the radiator, forward gain will be within 0.5 dB of optimum. Any changes, such as increasing the diameter of element tubing, will change the taper factor and require lengthening of these elements.

About Gain Figures

According to feasibility charts for a 3-element array, obtained from the *New Beam Antenna Handbook* mentioned above, the maximum forward gain possible at a given frequency and optimum boom spacing (0.45λ) is 7.8 dBd. An ad for a particular antenna manufacturer, however, states that their beam with the same configuration has 8.5 dBd gain! Since it has been shown in the past, however, that gains stated in ads are usually not rigorously verified (which in fact led several magazine to refuse to run ads for antennas with gain figures), don't hope for more than 8 dBd out of this configuration. Still, that's a hefty figure!

Front-to-back ratio is the most difficult of the two main characteristics of a beam to pin a value on. With the presence of earth ground, the ratio depends on the angle of the signal arriving at the rear of the array. It will vary widely between a low and high angle signal. Nonetheless, feasibility studies show that a typical F-to-B for this configuration is 25 dB.

Effects of Traps

The physical length of the trap coil and its inductance determine both the length of the inside element (that part of the radiator element in front of the trap) and the length of the lower frequency element beyond the trap. Essentially, the hat capacity of the trap shortens the inner length, and the coil inductance shortens the lower frequency stub dimension.

Figure 1 provides all of the element dimensions. All element material other than the boom has a wall thickness of 0.058″. This is the only size that will allow telescoping of elements and clearance of several thousandths of an inch. The boom wall thickness is 0.065″.

The center section of each parasitic element is a 12′ length of 1″ outer diameter (O.D.) tubing. A ⅞″ O.D. material telescopes therein, and where necessary for an additional taper, use a ¾″ O.D. material. The best aluminum tubing is 6061-T-6 (61S-T6) and comes in 12-foot lengths. You can also use Type 6063 T-8, sometimes used by manufacturers, though it is softer, and bends and fatigues more easily. The unreinforced 27′ plus 17 meter reflector bows a bit on the beam; you can insert a 10½′ section of ⅞″ material inside the 1″ center segment to double the wall thickness.

When determining the length of telescoping elements, be sure to allow 5″ to 8″ for the telescoping segment that holds the element in place. Cross-slot the ends of all element sections away from the boom, where telescoping will be required. To do this, use a hack saw to cut slots of 1¼″ to 1½″ and deburr with a fine tooth file. Slotting allows a good quality aircraft type hose clamp to bind the material securely.

I suggest coating all telescoping segments with an oxidation inhibitor, such as No Ox™, Ox-guard™, Cual-aid™, or Penetrox™. These trade names are available through electrical supply houses. Without this, you won't be able to slide the telescoped sections after a few months. If your climate is antenna-hostile, with rain, sleet, snow, and especially high salt content in the air, seal the door knob capacitor ends with plumber's white silicone sealant and position them beneath the element when you erect the antenna.

Gamma Matching Units

Figure 2 shows the gamma match dimensions. These are made of ½" O.D. tubing. A means for tuning out the inductive reactance of the gamma element must be provided. Salvage the dielectric and center conductor portion from sections of ½" coaxial cable: RG-8, RG-9, RG-11, RG-13, or equivalent. When telescoped into the ½" gamma element, this becomes a variable capacitor. The telescoping fit is rather loose, but tuning is broad enough for a stable value. Rule of thumb normally calls for approximately 7 pF per wavelength, but in this case 5 pF per λ works better. Use the length as shown in Figure 2 and follow all dimensions.

The center conductors of both sliding capacitors are tied together and connected to the center pin type "N" or UHF bulkhead connector. The connector is mounted close to the gamma feedpoint. The shell or shield side of the bulkhead connector is insulated from the boom. I used a 1/16" thick piece of Teflon™ for insulation and held the bulkhead assembly to the boom with a large hose clamp.

How do stacked gammas interact with one another? I found that with only one gamma in the circuit at a time, the tuned positions did not exactly coincide, as they did when both were in the circuit. I attribute this to a shift in the impedance point on the radiator due to loading by the additional gamma. But once the proper point has been established, the two units do not see each other due to their high "Q" at their respective frequencies. Electrically, only one is effectively in the circuit at a time.

Insulating Elements from the Boom

All five elements are insulated from the boom to prevent any reaction from boom resonance, if present, and to preserve a good front-to-back ratio. 10" or 11" sections of 1" schedule 40 PVC pipe slides over the 1" center elements. There are two ways to secure the PVC's rather loose fit. You can seal the PVC with a layer of plumber's white silicone sealant or by drilling a ¼" hole in the center of the PVC; then drilling and tapping an 8/32 hole at the 6' point of the element sections, lining up the holes of the PVC and the element. I prefer the latter method because the ¼" hole in the PVC not only simplifies alignment, but recesses the head of the screw. After securing the element with U-bolt and saddles, tighten the nuts to compress the PVC to the tubing.

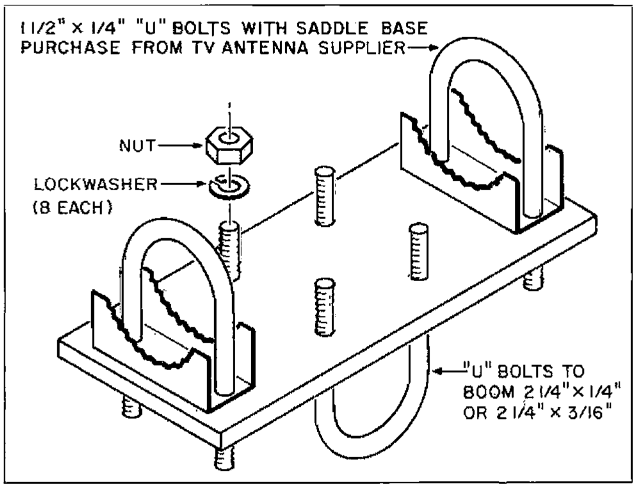


Figure 3. Parasitic and radiator element mounting plate.

Making the Trap Coils

Trap coils have disadvantages: they complicate determination of the length of the parasitic elements; increase gain loss due to the reduced element length; and add to construction problems. They're often a necessary evil, however, when designing a multiband beam.

I made the two 12 meter radiator traps with ⅛" aluminum wire. You can find this wire in well-stocked hardware stores or electrical supply houses. Buy the insulated type if possible.

My coils have a green transparent plastic insulation which stripped off the ends quite easily. The cost for 50' was under $6, and it'd be even less from an electrical supplier. You will need about six feet per coil. The coil requires 6½ turns of 3" diameter. Allow 2" to 2½" at the end of each coil so that it can be mounted centrally and have about ¾" in contact with the element.

Aircraft hose clamps hold the coil in place. Use the shaft of a ½" drill or other tool to initially space the coil turns. A 25 pF 5000 volt doorknob high-Q transmitting capacitor (or a pair of 50 pF in series) shunt and mount inside the coil. The capacitors are connected to lugs that contact the elements. The traps are made resonant between 24.3 and 24.6 MHz. The object is to present a very high reactance to the lower frequency element stub beyond the trap.

The insulating material for the traps is made of two 4¾" lengths of ¾" O.D. schedule 40 PVC pipe. Chuck about 2" of the material into a bench vise and cut two 9" lengths of ¾" element tubing. These will become the outer conductors of the traps.

The inside diameter of the ¾" PVC is too small to accommodate the ¾" aluminum tubing. Prepare the inside by either reaming or filing a small amount to help start insertion of the aluminum tube. Carefully heat the PVC end with a small propane torch. Keep moving the flame to prevent scorching the PVC. The material will soon become soft and pliable. Force about 2" of the 9" length of tubing into one end of the PVC, keeping the alignment straight.

To gain confidence, experiment a little with a sample piece. After completing the procedure for the short ends, do the other end of the coil. This time the length of ¾" tubing is 4¼ feet. This will become the 12 meter section that telescopes into the 1" diameter center section element.

When you're finished, clean up any burnt spots with a file or sandpaper. Drill a 6/32 tapped hole near the ends of the PVC about ½" to ¾". Drill clean through both the PVC and aluminum tubing to the opposite side. Tap the hole on both sides and use 1¼" long 6/32 screws. Slide a soldering lug, a 5/16" flat washer, onto the screw and screw it into the tapped hole and out the end. Secure using a flat washer, star washer, and nut. Repeat on the opposite end of the PVC.

CAUTION: Be sure to allow a proper distance between the lugs to accept the 25 pF capacitor. These screws and lugs become the connection for the capacitor to the 12 meter and 17 meter element sections as well as shunting the coil. Repeat the procedure for the second trap.

Perform the final grid dipping when the coils are in place on the antenna assembly. Dip for a frequency between 24.3 or 24.6

Parts List

Item	Tubing	Price/Ft.	Subtotal
1.	12', 1/2" O.D. x 0.058" Wall	0.73	$ 8.96
2.	12', 3/4 O.D. x 0.058 Wall	1.02	12.24
3.	60', 7/8 O.D. x 0.058 Wall	1.10	66.00
4.	60', 1" O.D. x 0.058 Wall	1.16	69.60
5.	24', 2" O.D. x 0.065 Wall "Boom"	2.79	66.96
6.	1 sheet 27½" x 10" x ⅛" 3½ lbs.	2.50/lb.	8.75
7.	50', ⅛" aluminum wire	5.75	
8.	14 ea. 2¼" x 5" x 5/16" U-Bolts	0.65 ea.	9.10
9.	10 ea. 1¼" x 3" x ¼" U-Bolts/Saddles	0.65 ea.	6.50
10.	1 ea. 8 oz. Tube, Oxguard/Oxidization/Inhibitor	4.79	4.79
Total			$258.65

The above total is near the *maximum* figure you would pay if you bought all the materials in single units. With salvaging and quantity orders, expect that figure to drop by as much as one half.

Note that in item 5, I used less than 18'. Item 7 required only 11'. This list doesn't include end caps, Adel collar clips, plumber's sealant, or sales tax. Also, about 1' of 2" x 0.225 wall aluminum tube must be milled to couple two pieces of boom material.

MHz. If the frequency is too low, the coil will need stretching (wider spacing between turns). You can adjust the coil length by repositioning the coil hose clamps. If the frequency is too high, you may have to squeeze the turns closer together.

Element to Boom Brackets

Figure 3 shows the bracket for holding the radiator and parasitic elements to the boom. This is made from ⅛" thick aluminum plate. The narrow dimension is 3¼" (if you use material 3/16" thick, you can reduce this to 3") and length is 9" to 10". The U-bolt should be ¼" to 5/16" in diameter, and have a saddle for seating the elements.

The U-bolts to the boom should also have saddles. These may be more difficult to find, but I would start looking for them at auto muffler shops. Check also in electrical and plumbing supply houses. You can use U-bolts without saddles on the boom, but they shift out of alignment after a time. If you can't find U-bolts with saddles, then drill, after aligning them, an 8/32" or 10/32" tapped hole through the element plate and boom and secure them with a short screw.

When assembly is completed, find a relatively clear area and mount the antenna between two wooden ladders. This is easier if your boom length extends 6" beyond the elements at either end. To block the assembly up, place short lengths of 2" x 4"s on edge under the element support plate. With the boom 5' above ground, you have easy access for the initial tuning.

"The forward gain of this beam approaches 8 dBd and has a front-to-back ratio of 25 dB."

Initial Tuning and Settings

Prepare a 3-5 foot length of small diameter 50Ω cable (RG-58 or equivalent). Put a coax connector on one end to mate with the one on the array, and make a 3" loop at the other end (center conductor to shield) to couple with the coil of a grid dip test instrument. Disconnect the sliding connectors of the gammas. Coupling between the gamma element and the radiator should be sufficient for measuring the radiator resonance.

Starting with 12 meters, look for a dip near 24.9 MHz. There may be a number of dips over a wide frequency range, but concentrate on those of concern. When you locate one near the frequency, verify it by touching the coil or the radiator element ahead of the coil. The frequency dip will shift or disappear. By adjusting the length of the 12 meter telescoping section (that portion of the element ahead of the trap), you should be able to set the resonant frequency to 24.94 MHz. Touching the stub element beyond the trap should not disturb the dip, indicating that the trap is performing properly. Mark the point of insertion of the 12 meter element with pencil or paper tape. If you have not located a dip by now, you may have to connect the sliding contact of the gamma. But, using this system, I had no problem locating any of the dips. Adjust both left and right sections of the dipole to the same dimensions.

Now, locate the 17 meter radiator resonance. Once you find it, adjust the 17 meter stub for a frequency of 18.11 MHz. The stub will be very sensitive as to position.

Loading and Adjusting the Beam

The unit is now ready for an RF energy test. You will need a Bird Model 43 or equivalent, and a 1 or 5 watt Bird slug element (the directional coupler element). Connect both gamma sliding contacts to the approximate dimensional positions.

Before continuing, remember that you are in the RF field of the radiated energy. Low power (below ten watts) is fine, but be careful to not pump much more RF than that into the beam while working near it, especially while standing in the beam path. Only you are responsible for taking the necessary precautions here!

Begin by applying 1 or 5 watts, depending on the full scale rating of the wattmeter element at a frequency of 24.94 MHz. Reverse the direction of the Bird slug element. The meter now indicates the magnitude of the reflected energy. Move yourself out of the field of the radiator, and observe the meter indication. Adjust the 12 meter gamma sliding contact to reduce the reflected power indication, thus reducing the SWR.

You may achieve further reduction by making a small adjustment in the length of the 12 meter element section. Adjust both sides of the element equally. With this minimized to a small percentage of the scale, change frequency to 18.11 MHz and re-establish the power setting. Adjust the gamma slide contact on the 17 meter gamma for minimum reflected indication. Further adjustment is made by positioning the 17 meter stub element beyond the trap. The end section adjustment is very sensitive to length and the proximity of your body. Adjust for minimum indication. Halve the perceived change length needed for each element, since the other end of the element must also be adjusted by the same amount, to maintain dipole length symmetry. For example, should you find a change of ½" is required, then change it by ¼" on the first element end, and then go to the other end of the dipole and set the length by the same amount (to total ½") so that the stub lengths are equal. Keep repeating these adjustments until you achieve unity or minimum SWR.

Be sure to adjust for 12 meters first, since these adjustments affect the 17 meter element/gamma match tunings. When completed, reposition the array. Set the reflector end on the ground and prop the director end up in the air 45 to 70 degrees and in the clear. For this, I suggest using a 6-foot length of 2" x 4". Notch out one end so that it will cradle the 2" boom material at a point behind the 12 meter director. Using C-clamps, attach the 2" x 4" to the side of a six-foot ladder. Position the ladder so that it supports the boom with the antenna facing upwards and away from any nearby obstacles, like trees or buildings.

Once again, check for minimum reflection indication. And touch up on gamma slide contact position and element lengths. Start with 12 meters and conclude with 17 meters. At this point, expect little change.

Further tuning depends on the type of your tower and its location. It's best to final-tune the antenna at operational height, though this is impossible most of the time.

If the tower is crank-up or tilt, so much the better. First lower it to minimum height. If there is a sturdy nearby structure, stand on it to insert the sliding elements, having marked the position of and removed these elements before mounting the boom to the mast. When the sliders are out, there is only 6 feet of element on each side of the boom. Still, erection is a two-person job.

Insert the telescoping elements after the antenna is in place on the tower. I was able to position my antenna at 15 or so feet, and make finite element adjustments at that height. Very little adjustment was necessary. At worse, if no further adjustment is physically possible, the most you'd lose in gain would be ½–¾ dB. With my array at full height (45 feet), I have unity SWR on 17 meters and and a maximum of 1.3:1 on 12 meters. My 940S automatic antenna tuner allows me to obtain a perfect conjugate match of the entire system on both bands. A conjugate match keeps all the system currents in phase. With frequencies in the HF spectrum and ½" variety transmission line, there will essentially be no loss, and any reflected energy on the line will eventually be radiated.

Performance

With 100 watts into the transmission line, my signals on either band are consistently among the stronger on the band. Minutes after erecting the dual band beam, I got on the air, and immediately worked IK6BAK in Cesena, Italy, on 12 m, and ZL1PD, in Auckland, New Zealand, on 17 meters. Both answered immediately on my initial abbreviated call during a pile-up, and gave me a resounding 5-9+ report. From my QTH, you just can't get much further away than Auckland! And that was just the beginning of many long and rewarding DX QSOs on these two new WARC bands with the dual-bander.

I hope you have as much fun as I did building and using this beam! Let me hear from you. An SASE is sure to get a reply. 73

Robert E. Bloom W6YUY has worked in many phases of radiocommunications engineering, including broadcasting, antenna design, and tower structure design. He has had his ticket since the early thirties. Bob can be reached at 8622 Rubio Ave., Sepulveda CA 91343.

Kaboom Micro Keyer

Iambic keyer in the palm of your hand!

by Michael Jay Geier KB1UM

Sure, most of us use VHF, but have you ever thought about operating HF mobile? You might be surprised at how many hams run HF rigs in their cars. Of course, they only use SSB, right? Wrong! Many hams use other modes, such as CW and RTTY, and why not? While I don't recommend running RTTY while driving (though it's fine if you're just a passenger), you can use CW without causing dangerous driver distraction. And its weak-signal capabilities make it especially suited to mobile operation, where fading signals and high noise levels sometimes obscure other modes.

The bug hit me while I was on a long trip with my TS-120S blaring away on SSB. I decided to do a little CW listening to pass the time, and found it no trouble to copy in my head as I drove. So, I thought, why not send as well?

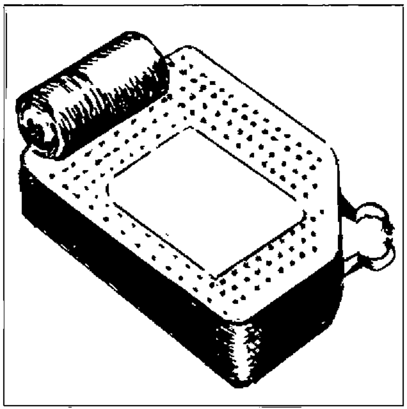
Searching for the Key

Certainly, I'd heard of mobile CW operation. In fact, there were mobile ops when CW was the only mode! Obviously, I'd have to work out some sort of key arrangement which would be safe (absolutely the prime consideration!), comfortable, and convenient.

A straight key was out. The bumping and jarring of my compact car made the manual generation of dits and dahs impossible. Some sort of keyer seemed like a good idea, and I like iambic keyers, anyway. I tried using my Bencher paddle on the seat, but that required my arm to be placed in an uncomfortable and fatiguing position, and the paddle wobbled around too much on the upholstery. Finally, I decided to use the ol' ham spirit and build a keyer optimized for the intended use.

Easy Circuit

Fortunately, a simple keyer doesn't require much circuitry these days, thanks to the amazing Curtis 8044 series of ICs. One of these chips provides most of the guts, and only a few other components are required. 8044 CMOS iambic keyer chips are available from *Curtis Electro Devices, Inc., Box 4090, Mountain View CA 94040. Tel. (415) 964-3846.*



The Kaboom Micro Keyer.

See the figure for the circuit of the Micro Keyer. I chose an open-collector transistor output, which keys my Kenwood with no difficulty. Some rigs, such as certain ICOMs, require a very low impedance contact closure, and thus won't key properly with a bipolar transistor. A power FET will usually do the job.

> **"Fortunately, a simple keyer doesn't require much circuitry these days . . ."**

Whence Paddles?

OK, so the circuit was easy. What about paddles? I wanted the entire unit to fit into my hand, so the paddles had to be much smaller than any of those commercially available. A search of the junk box yielded two microswitches, each with a lever arm. Placing them at right angles revealed that they could indeed function as paddles. They click, but the sound is barely audible in the noise of the car. In fact, the feel of the switches clicking provides nice tactile feedback.

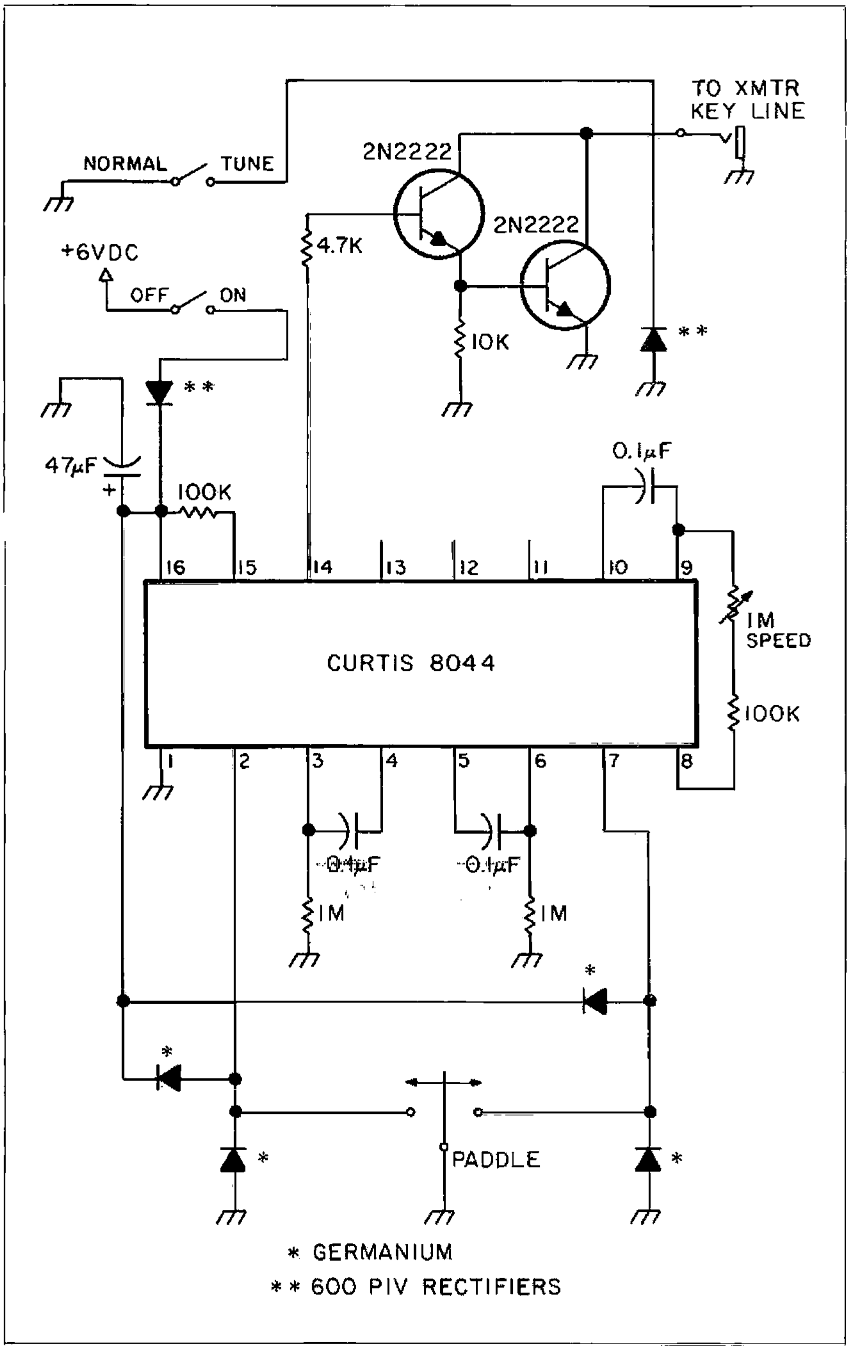
Et Voilà!

The photo shows the completed unit. The paddles protrude from the forward right corner, which allows you to place the microswitches in the most space-efficient configuration. It also permits you to operate them with the thumb and index finger when the unit is held in the palm. As a bonus, you can also use the keyer with it lying flat on a table.

I put the circuit together in one afternoon, using point-to-point wiring on perfboard. Any type of construction will do, but this technique lets you cram the parts close together. Output is through a standard earphone-type mini-jack. Two DIP switches on the back turn the keyer on and off, and short the output so you can tune your rig with a continuous carrier.

The case is made of more perfboard, held together with hot melt glue. Those of you with good mechanical construction skills can certainly do better. Two wires, glued so that they limit the travel of the microswitches' arms, are bent so that the arms rest very close to the switching point, making for tight, fast paddle action. The trimpot for the keyer speed is adjusted with a screwdriver, through a small hole in the case top.

The battery, soldered in and glued on top, is a 6-volt Energizer purchased at Radio Shack. It's much smaller than the usual 9-volt square type. Omitting the battery holder keeps the size to a minimum. The keyer eats so little current that I am still on my first battery after two years of (admittedly infrequent) operation! Be careful not to overheat the battery when soldering, or you will ruin it. If you intend to use the keyer very often, or



The circuit for the Kaboom Micro Keyer.

you don't care to solder to the battery, use a holder.

Operating Tips

In keeping with the unit's small size, there is no sidetone built in. Nearly all HF rigs provide one anyway. With the keyer in your palm, the paddles should rest between your thumb and index finger. Lefties can build the whole thing in mirror image.

The first time I tried it, RF from the mobile whip locked up the rig, and I got a nasty RF burn from the keyer's output jack. Switching to a shielded connection cable and wrapping it through toroids, one on each end, solved the problem. I've since made numerous contacts, and the little unit has performed like a champ.

This handy little keyer is good for Field Day, QRP, contests, and VHF CW, as well as HF mobile. Anywhere you need it, the Kaboom Micro Keyer will give you a handful of pure iambic power. And jaws will drop at the local radio club when you pass it around! 73

Michael Geier KB1UM is 73's trouble-shooting " : Kaboom" columnist. You can reach him at 7 Simpson Court, S. Burlington VT 05403.

by Marc Stern N1BLH

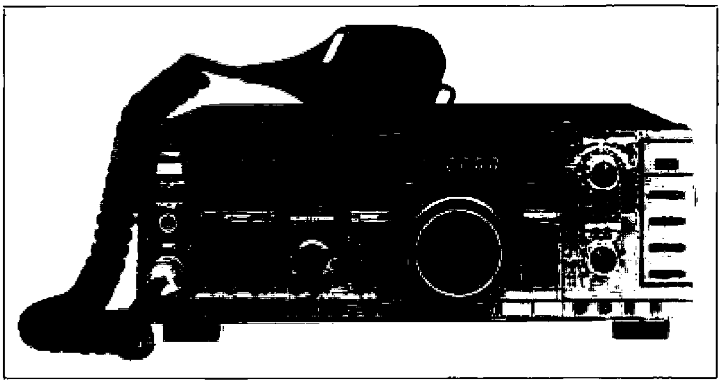
Kenwood TS-680S HF Transceiver

Improvements on the trusty TS-140S.

Kenwood USA Corporation
2201 E. Dominguez St.
Long Beach CA 90801-5745
Tel: (213) 639-4200.
Price Class: $1150

What Is the 680S?

In brief, Kenwood took the TS-140S, a high performance uncomplicated HF mobile rig, and added to it 6 meters and a receive preamp that is active beginning at 21 MHz. (See review of the 140S in the April '88 issue of *73*.) Like the 140S, the 680S has a general coverage receiver, but even the receiver has an added feature—45 to 55 MHz, low VHF coverage.


The Kenwood TS-680S. It is a twin to the 140S, with 6 meters and preamp added.

Close Brothers

Since the 140S and 680S are so similar, I don't elaborate on the features here. I list them, though, for those not familiar with the 140S.

The front panel of the TS-680S contains 34 controls, which are clearly labeled, and ergonometrically well-laid out. Those with thick, blunt fingers, though, should check the rig out before buying, since some of the buttons are small.

Like all modern HF rigs, the 680S is microprocessor-controlled. It has a multi-function display that gives not only mode, but also frequency, memory channel, mode, RIT, VFO (there are two), and frequency to 10 Hz. There are also on-air indicators, as well as a series of LEDs that light up when you activate the memory scroll and allow you to see the contents of the 31 memories, or frequency lock.

Other notable features include memory, VFO, and programmed scanning; a multifunction S-meter; LSB, USB, CW (QSK), AM, and FM modes; split operation; 8.8 kHz range RIT; IF shift to tune out QRM; 20 dB of front-end attenuation to protect your rig from local high-power stations; and speech processing.

The rear panel contains connectors for the antenna and DC power. Two accessory jacks allow computer control and operation, as well as remote control.

The rig is also fairly compact because it has a built-in cooling fan (like the ICOM IC-735) that eliminates the need for a heatsink.

Something Gained, Something Lost

The only 140S standard feature that's non-standard on the TS-680 is VOX operation. Since the chassis of the 680 and its predecessor are essentially the same, something had to make way for the pre-amp.

For many hams, it's a more than acceptable trade-off. There are some operators who prefer VOX—and it's an accessory option offered for the 680. Many, though, are happier with PTT operation. Finding the proper VOX level in many rigs can be very tricky business, especially if the rig isn't thoroughly grounded. Without thorough RF grounding, ambient RF tends to creep up, and into, the microphone, and key up the rig unless you have the VOX set at such a high threshold that a thundering herd of elephants couldn't activate it! So I, like many others, prefer the lack of complication PTT operation offers.

A few years ago, VOX was far more important because it allowed me semi-break-in CW keying. However, the TS-680S features built-in QSK or semi-QSK, obviating that need.

Why the Pre-Amp?

As you move up toward VHF, such rigs tend to generate their own system noise, which is superimposed on any atmospheric noise your rig picks up. This combo can often drown out weak signal stations. A super front end helps, and a pre-amp—a device that amplifies incoming signals just as they arrive to the rig—can make all the difference in the world.

Testing the Specs

Kenwood rates the 680S at 110 watts out, and my testing confirms this. The 680 consistently pumped 80 to 110 watts into a 50Ω resistive load and kept this up for a long time on the HF bands. From 50 to 54 MHz, it puts out only 10 watts, so you may want to think about getting an amp. VSWR protection came on over 1.5:1, which is something that has been common in other Kenwood gear I have tried.

I found that the pre-amp adds about 1.5 S-units to the receive capability of the rig (roughly 10 dB or so).

Suggested Improvements

Overall, I have surprisingly few nits to pick at in the TS-680S, and those that I do have are easy to live with. For starters, I found that the power slide switch is anything but linear. A small movement produced a radically large increase in output power. Kenwood would be well-advised to swap the power output function with one of the knobs, or combine it with a concentric control knob surrounding one of the other control knobs.

I also found the display a little dim in bright daylight when I used the 680 mobile. Next, at 10 inches by 11 inches by 4 inches, and weighing 13 pounds, it may be a little bulky for smaller cars such as sub-compacts.

Finally, the (two) slide control noise blankers are effective against ignition noise and pulse-type "woodpecker" noise, but after a point they also affect the quality of the signal, causing it to pump and become distorted. All you have to do is remember to keep the adjustment below halfway and you'll be okay.

Conclusion

To sum everything up, I found the TS-680S multibander quite a good radio. It measured up to, or exceeds, its specs and is a pleasure to operate. The addition of the six meter module and pre-amp makes it a good value for the few extra hundred dollars the 680S lists for over the 140S. 73

3/4 Inverted "U" for 160m

Be heard on the Gentlemen's Band.

by Alan Hoffmaster WA3EKL

Twelve years ago, when I decided to start some serious contesting, I immediately realized that I needed a good 160 meter antenna. That presented a problem, since my backyard was 63 feet wide and 140 feet deep.

About 60 feet from the house, my one lonely 65-foot guyed tower stood. Hanging from one end was a 20-foot pressure treated 2 x 4 with a 75 meter inverted vee; hanging off the other end was a 40 meter inverted vee. A 3-element, 75 meter sloper array hung from the top. A tribander and monoband antennas were living at the top, as well as down the sides, of my tower.

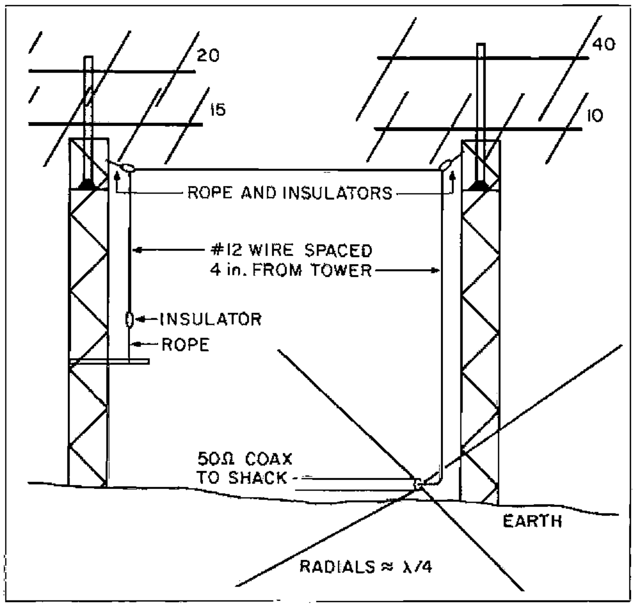


Diagram of WA3EKL's 160m inverted "U" antenna.

Experimenting with Shunt Feed

After reading a considerable amount on 160 meter antennas, I first decided to shunt-feed the tower. The shunt consisted of a #10 copper wire that ran parallel to the tower and stood off from it by four feet. The top of the wire attached to an aluminum pipe, grounded to the tower at fifty feet up. I fed the bottom end of the wire with 50Ω coax through a 250 pF capacitor. I attached the shield of the coax to six radials strung out in the yard. With this system, I could cover about 50 kHz without going over 2:1 SWR. The antenna got out, but that's all I can give it.

According to the material I read, mounting a tribander or monobander at the top of the tower would make the tower "look" longer, and make it easier to load on 160 meters. My experience, however, didn't bear this out at all. In the course of some years, I had seven different configurations at the top of my tower, ranging from two stacked beams, to nothing but the mast pole jutting up seven feet from the top plate. None of these combinations ever affected the 160 meter shunt feed system!

Simpler Way to 160

About five years ago, I installed another tower 55 feet away from my original tower.

"I can tune from 1.8 MHz to 1.9 MHz without going over 1.8:1 SWR."

See the figure. I cut a ¼-wavelength of #12 copper wire for 160 meters and connected one end directly to the center conductor of a piece of coax that went to the transmitter. The coax shield attached to the same ground radial system I used for the shunt system.

I strung the wire 65 feet up the side of the original tower to the top, four inches from the tower, then across the sky, parallel with the ground, to the other tower and down the side of this tower, also standing it off by four inches. I insulated the wire from both towers using rope and pieces of wood.

The first SWR check indicated resonance out of the top of the band, so I added about twenty feet of wire to the free end. The SWR was now 1:1 at 1.850 MHz. I can tune from 1.8 MHz to 1.9 MHz without going over 1.8:1 SWR.

I had found a solution: the inverted U, a modification of the old inverted L.

Good DXing

The antenna works extremely well. During DX contests I can work anything I can hear. In fact, it is a bit of an alligator. The DXers hear me better than I hear them.

If you are going to try this antenna, I would suggest that you raise the first vertical section of wire to the highest support you can find. Then stretch the rest of the wire to the next highest support you can find. If you have any wire left over, let it hang down on a weight, or tie it off with a rope. To tune the antenna, add or subtract wire to this end. Good luck, and I hope I hear you on the top band! 73

Alan Hoffmaster WA3EKL has been a ham for 25 years, and he enjoys creating and testing antenna systems. His address is 929 Andrews Road, Glen Burnie, MD 21061.

HAM PROFILES

There are no "average" hams!

Ham in the Limelight

Eighteen-year-old Kelly Howard N6PNY discovered amateur radio—from her parents—at age thirteen. After studying with the Convair ARC, Kelly became KB6DOS, and upgraded to General two years later. A chance meeting with Fried Heyn WA6WZO in a San Diego amateur radio supply store led to her appearing in the *New World of Amateur Radio* videotape.

In February, Kelly was back in front of the camera interviewing retired US Senator Barry M. Goldwater K7UGA for the pilot of an in-school children's TV program, *Today's People*. Two months later, she and her co-star from the *New World of Amateur Radio*, Nathan Pyle KB6PLH, attended the Dayton Hamvention with expenses paid by the Convair ARC and several other clubs. Kelly was invited to sit at the dais with banquet speaker Dave Bell W6AQ and Ham of the Year Bill Pasternak WA6ITF.

Kelly graduated from high school this year and will study broadcast journalism in college this fall. She has been promised an internship at a Los Angeles television station. While Kelly continues working with *Today's People*, she is also one of the regular anchors of the Westlink Amateur Radio Newsline reports. Thanks to ham radio, life is never dull for Kelly Howard N6PNY.

Kelly Howard N6PNY—high profile ham.

Multi-Talented Ham

Hugh Morris Archer W8JA, born on June 22, 1916 and now living in Dearborn, Michigan, became interested in radio when he was twelve. He started off his long career in hamming when his science teacher gave him a diagram and parts to a one-tube radio. He put it together and they spent many happy hours together.

Hugh M. Archer W8JA—inventor, business executive, scientist, engineer, sportsman, attorney, researcher, community leader.

Hugh, known to fellow hams as W8JA, belongs to ROAR, the Rotarians of Amateur Radio. His favorite way to spend a Sunday morning is to get on the air at 7 AM. As the sun moves west, so do his conversations: from Greece to Finland, Sweden, Norway, Germany, France, England, Italy, then Canada, the East Coast, and South America.

On July 1, 1989, he took office as President of Rotary International. For a year, he will head an organization of more than one million business and professional members in 165 countries. He finds amateur radio great for helping with serious Rotary business, such as disaster relief. "Amateurs have made many contributions to the science of communication," he says, and good communication is one reason the Rotary is a successful service organization.

Among his many achievements are six inventions registered with the US Patent Office, two of which built his plastics extrusion industry, the Spiratex Company in Romulus, Michigan. One is for a spiral winding process and apparatus, another for a method of forming plastic rods and profiles. He has also invented medical equipment and several types of light meters.

To obtain guidelines to submit items to Ham Profiles, call Joyce at 603-525-4201 Ex. 551, or download them from the 73 BBS (PH: 603-525-4438, 8 data bits, no parity, one stop bit). 73

FEEDBACK

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The Hamfester

This unit gives you easier and longer range HT communications in crowds.

by Rev. Kenneth D. Wells NM9P

Hamfest season was approaching quickly and I needed a way to keep in touch with my buddies (and the XYL) while browsing through the flea market. I hated the stabbing pains I got when my rubber duck antenna jabbed me in the side. Besides, range was not very good with the antenna tucked neatly under my armpit. There had to be a better way. Here is how my solution evolved.

At the Dayton Hamfest I found a booth selling the Duckie Clip™, a three-foot coax extension with a spring clip, for about ten dollars. You could make it for less than ten dollars, but buying this model saves lots of time, and the construction quality is excellent. With this neat little item, I could clip my rubber duckie to my hat, and leave the HT on my belt. The effective communications range increased greatly: Now my buddies and I could find each other for lunch!

I clipped my speaker mike to my collar where I could hear everything on the frequency. This worked, but there were several problems. In a noisy location, I couldn't hear the tiny speaker. In a quiet location, everyone else could hear it and gave me dirty looks. Whenever someone called, I always seemed to have something in my hand that kept me from grabbing the mike and answering back. There had to be a better way.

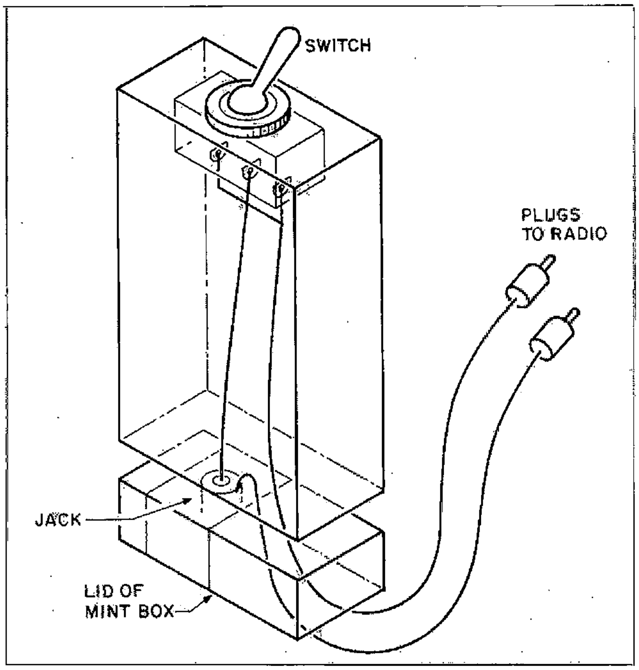


Figure 1. Physical layout of hamfester.

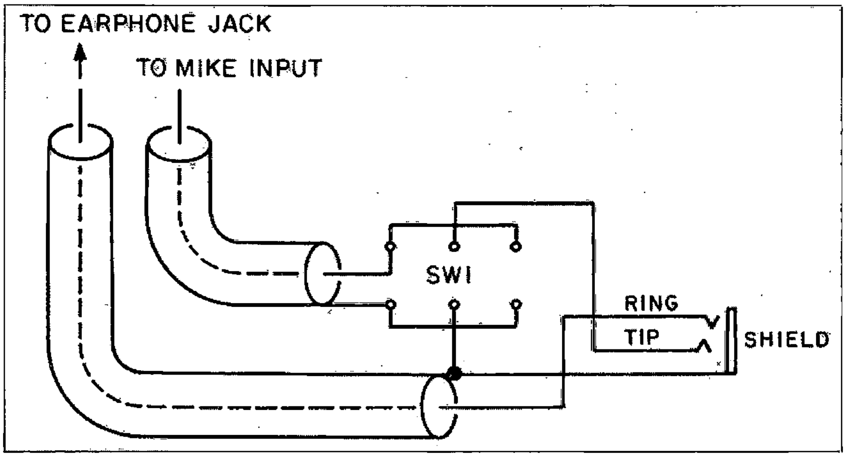


Figure 2. Hamfester wiring diagram

The Better Way

Some of my buddies bought boom mike headsets. They looked like just the solution, so I priced one on my next trip to the ham equipment dealer. Wow! $55! I'm basically cheap, so nix the headset.

Soon, however, I noticed that K-Mart was selling a boom headset telephone for $20, which soon dropped to less than $14! The phone consists of a boom mike with a single earpiece. It connects to an interface box by means of a miniature stereo plug. BINGO! All I needed was another interface box and I could use the headset for both telephone and ham radio. (By the way, it works nicely as a telephone, but you need another phone to do the dialing.)

I built the interface box into the plastic case from a pack of breath mints (about 50 cents in any grocery store). All I needed was a mini-stereo jack, a center off spring return DPDT switch, two short lengths of RG-174 or other shielded wire, a miniature stereo plug, and a subminiature phone plug. I bought these at Radio Shack.

Drill carefully into the bottom of the plastic case—the plastic splits easily. The switch fits perfectly into the case (Figure 1). To install the jack, drill or ream a hole slightly smaller than the jack diameter into the soft plastic lid, and press in the jack. There is no room for a

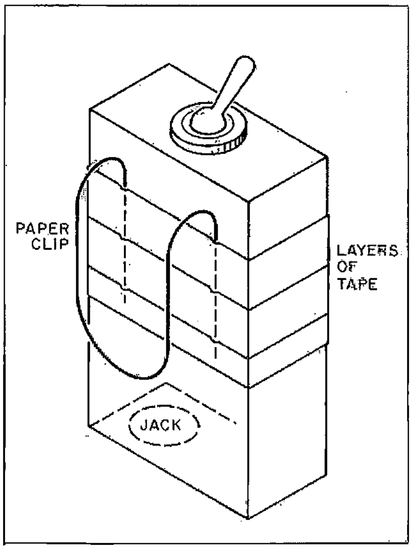


Figure 3. Hamfester pocket clip, made from a jumbo paper clip.

Parts List

(Numbers with "RS" are from Radio Shack)

Part	Source	Cost	
HS1 Headset Telephone	K-Mart	$13.88	
J1 Miniature Stereo Jack	RS 274-249	$ 0.80	(2 for $1.59)
J2 Miniature Stereo Plug	RS 274-284	$ 1.10	(2 for $2.19)
J3 Subminiature Phone Plug	RS 274-290	$ 0.75	(2 for $1.49)
S1 DPDT C.O. Spring Return	RS 275-637	$ 3.69	
Shielded Mike Cable	RS 278-752	$ 3.29	for 30 feet
"Duckie Clip"	Hamfest vendor	$ 9.95	
Case (Tic-Tac Mints)	Grocery store	$ 0.45	(including mints)
Total Cost:		$33.91	
Stereo Headphone	Discount Store	$ 4.95	(plus or minus)
M1 PC-Mount Electret Mike	RS 270-090	$ 1.39	(sale price $0.99)
Heat Shrink Tubings	RS 278-1627	$ 0.26	(7 for $1.79)
Total Cost (without Phone):		$26.63	

I got most of these parts during sales at Radio Shack, so they were much cheaper.

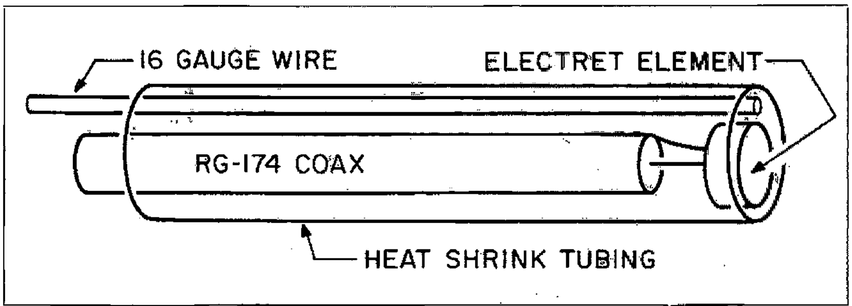


Figure 4. If you can't find the boom mike at K-Mart. . . home-brew it!

nut, but the soft plastic grips the jack tightly enough.

Following the wiring diagram in Figure 2, connect all wires before the final installation of the switch and jack. Cut a notch into the lid just large enough for the cables to fit through. Hold the lid closed with a layer of electrical tape. Bend a jumbo paper clip into a folded "U" and fasten it to the interface box with another layer of electrical tape (Figure 3). Now the box will hang nicely on a shirt pocket or belt.

My HT, a Kenwood TR-2600, switches differently than other HTs. The earphone connects to a subminiature plug. I wired this straight through. The mike is wired to the center connection of the miniature stereo plug. T-R switching occurs when the ground of the mike jack is connected to the ground connection of the earphone jack. The DPDT switch ensures that both the center conductor and the ground of the mike are completely disconnected from the circuit when in standby. Otherwise, leakage through the electret mike causes the transmitter to key up.

Adaptations

You can use this mike and interface box with other hand-held radios. Just change the plugs to match your rig. The ICOM IC-2AT uses the subminiature plug for mike input and miniature plug for the earphone. You may need to solder a 33k resistor across the cable at the switch to maintain a good key-up of the transmitter. Some radios need it, others don't. If yours works fine without it, leave it out. Be sure that the resistor is soldered on the mike side of the switch and not the radio side, or the rig will be constantly keyed up. This will get you a dead battery and lots of enemies.

Communication is now just a flip of a switch away. I can hear the gang calling, even in a noisy room, and I don't disturb other people in a quiet room. I even sat through the Packet Radio forum at Dayton and listened to my buddies make the lunch date, without missing a byte!

Home-brew a Headset

If you can't find this headset telephone, or one like it, you can build your own using a cheap set of stereo headphones. First, build a boom mike using a 99-cent electret element from Radio Shack. Use RG-174 or other small shielded wire for the feedline, and place a length of 16 gauge wire alongside it for stiffness (Figure 4).

Encase the works in heat shrink tubing. Use two or three concentric short lengths of heat shrink right next to the mike element. This gives a neat tapered look and adds to the strength of the assembly. Leave a few inches of the 16-gauge wire extending from the shrink tubing and twist it to the headset band. Then, just cut off one of the earphones and use the remaining cable to connect to the boom mike. Voila! A headset and boom mike. You can use either side for the headphone, just remember to wire the jack on the interface box accordingly.

I have constructed several of these headsets and used them in different configurations on my ICOM IC-745 on the low bands. They are a joy during contests, but describing that needs another article!

Convenience

This headset is also very handy for public service communication at parades, walk-a-thons, etc. The headphone keeps conversations private and does not disturb others. Hands are now free to write, browse, eat, or bandage knees. The extra three feet of height and clear shot for the antenna really increases communication range. As an added plus, NO9N in Vincennes discovered that when wearing the typical "baseball cap" (with call sign and club emblem, of course) the mike may be pivoted up under the bill and it still works like a champ. Evidently the bill reflects the sound back into the mike much like in a PZM microphone. Many people may be unaware that you have a mike at all, and wonder why you keep talking to yourself!

I have had a lot of fun with this headset combo. The best fun was showing it off at the local ham club meeting and hearing all the oohs and aahs from fellow club members! After all, "I built it myself!" 73

Rev. Kenneth Wells NM9P is President of the Old Post Amateur Radio Society and Pastor of the Wabash United Methodist Church in Vincennes, Indiana. Contact him at 212 West Central, Greensburg IN 47240.

Vertical Antennas at HF —Part I—

This tutorial uncovers surprising facts about vertical HF antennas.

by Stan Gibilisco W1GV

The Misunderstood Vertical

Hams often disparage HF verticals. They criticize them as antennas that "radiate equally poorly in all directions," that require an extensive ground-radial system to get out at all, and that are too noisy for reception.

Well, there's more to the story than the blanket statements above suggest. When properly set up, verticals—even those without radials—are fine performers on both transmit and receive. This two-part tutorial will serve to separate fact from fiction. But first, a little background.

Polarization

An electromagnetic wave, as the name suggests, has two components—an electric (E) wave and a magnetic (H) wave. These components propagate in planes 90 degrees to each other. When we talk about the polarization of a wave, we typically mean the E-wave orientation. A vertical antenna radiates E-M waves whose E-fields are mostly vertically polarized. It also receives most effectively when the incoming signal is vertically polarized.

In free space, the attenuation presented by a vertical antenna when the incoming signal is horizontally polarized is 30 dB. In practice, however, many factors serve to alter signal polarization. When the wave is a ground wave, then hills, telephone and electric wires, steel-frame buildings, and even trees refract E-M waves and rotate their polarization. (Note, though, that they do not significantly absorb wave energy at HF—regardless of the polarization.) The ionosphere also rotates the HF wave around its propagation axis, altering its polarization and so causing the sky wave to arrive back to Earth with varying polarization. This is why a horizontal antenna works for reception of sky-wave signals that have been transmitted originally by a vertical antenna, and vice versa.

Low Band HF Ground Wave

So, you can see that sky-wave propagation for vertically and horizontally polarized signals at HF differs little. However, the surface wave—a signal that travels using the ground as a conducting circuit—is limited to line-of-sight for horizontally polarized HF signals. This is because their E-M fields are short-circuited by the ground. With vertical polarization, however, the ground doesn't short circuit, but actually assists E-M field propagation over its surface (see Figure 1).

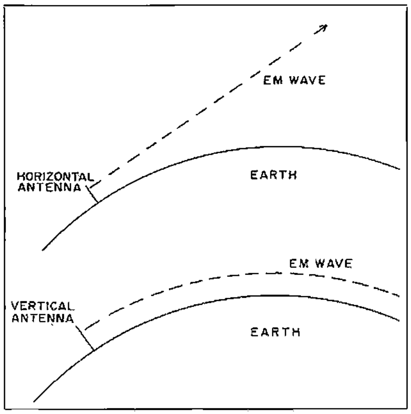


Figure 1. Electromagnetic waves from (a) a horizontal antenna, and, (b) a vertical antenna. This pattern holds true for wave energy up to 10 MHz.

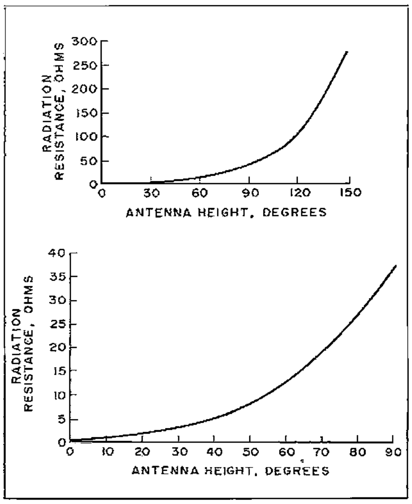


Figure 2. Radiation resistance as a function of height for a vertical radiator over perfectly conducting ground. The feedpoint is assumed to be at the base of the antenna. (a) shows heights from 0–150 electrical degrees. (b) shows them only from 0–90 electrical degrees.

This effect is very slight at frequencies above about 10 MHz because of ground loss, but, as the frequency is lowered, the surface wave reaches further and further from the transmitting antenna. While surface-wave propagation is limited to the radio (line-of-sight) horizon above 10 MHz, a high-powered (1.5 kW output) station may be heard at distances of about 50 miles at 7 MHz, 100 miles at 3.5 MHz, 150 miles at 1.8 MHz, and 200 miles in the standard AM broadcast band in the daytime, all when there is little or no sky-wave propagation.

This is why antennas for standard AM broadcast are almost always vertical! They radiate vertically, so that surface-wave propagation is optimized for maximum coverage during daylight hours.

At frequencies above 10 MHz, there is little difference in coverage between vertically and horizontally polarized wave energy, all other factors being equal.

Longer Skip Length

Vertical antennas (at frequencies below about 10 MHz) often provide good radiation at small angles relative to the horizon, which often enhances DX. A vertical antenna ¼ wavelength high, fed against perfectly conducting ground, will usually radiate most of its energy at an angle of less than 45 degrees with respect to the horizon.

DXers like this because, the lower the angle of radiation from an antenna, the greater the single-hop sky-wave propagation distance will be, requiring fewer hops to reach a given distant point. The upshot is that a signal travels a greater terrestrial distance with less attenuation.

Horizontal antennas must be at least ½ wavelength off the ground to obtain the same low-angle characteristics as a well-designed and installed quarter-wavelength vertical antenna.

Table 1 shows approximate heights of a ¼ wavelength vertical antenna, based on frequency (MHz). Heights are shown for the amateur bands at 160, 80/75, 40, 30, 20, 15, and 10 meters. Lengths are shown for bottom and top band frequencies, except in 30, 20 and 15 meters. The general formula is:

$$L = 230/f$$

where L is length in feet and f is frequency in MHz.

When Ground is Important

A good, highly conductive ground system is essential if a quarter-wave resonant vertical antenna is to perform well. This doesn't always hold true, however, for a half-wave vertical antenna, the other common type of vertical antenna.

The ground reflects electromagnetic energy. Ideally the ground would act like a copper plate—that is, as a perfect conductor and reflector—but this is not true of real earth. Salt water comes closest to the ideal; and black earth and fresh water are also fairly good. The conductivity of sandy and rocky, dry soil is the poorest, scarcely better than no ground at all. You can improve ground conductivity by burying radial wires a few inches below, or stringing them along, the Earth's surface.

Your antenna should have as high a radiation resistance as possible compared to the ground resistance, since the higher that ratio, the greater the proportion of the wave energy entering the antenna/ground system that radiates into the atmosphere. You can achieve this favorable ratio by 1) designing your antenna system to have a greater radiation resistance, 2) by reducing your ground resistance or 3) both. Clearly, a good, low-resistance ground becomes more important as the radiation resistance of an antenna decreases.

It is a fascinating concept, but we will go into only enough detail to graph the radiation resistance as a function of antenna height in electrical degrees (Figure 2a,b).

For a base-fed vertical, the radiation resistance increases with the height of the antenna element. Note that for a vertical 90 degrees (¼ wavelength) high, the radiation resistance is about 37Ω. For an antenna 180 degrees (½ wavelength) high, the radiation resistance is very high, on the order of hundreds or even thousands of ohms, depending on the ratio of conductor diameter to conductor length.

As alluded to above, the efficiency—the amount of wave energy radiated into the atmosphere—of a vertical, base-fed antenna depends on the ratio of the radiation resistance to the total resistance in the antenna system. The total resistance, R_T equals the sum of the radiation resistance R_R and the loss resistance R_L. The value of R_L is determined by the conductivity of the ground in the vicinity of the antenna, and by loss in the antenna conductor and the feedline. In most antenna systems the conductor and feedline loss is less than 1Ω, but the ground loss may be much greater. It is not at all unusual for the ground resistance to exceed the value of 37Ω. This means that it is quite possible for a quarter-wave vertical antenna to have an efficiency of less than 50 percent.

The formula for antenna efficiency, *Eff*, is:

$$\mathrm{Eff}(\%) = 100R_R/(R_R + R_L)$$

For example, suppose we have a quarter-wave vertical antenna with a loss resitance of 15Ω. Then $R_L = 15$ and $R_R = 37$, according to Figure 4. We calculate:

$$\mathrm{Eff}(\%) = 100(37/(37 + 15)) = 100(37/52) = 71 \text{ percent}$$

Interestingly, this total resistance $R_T = 52\Omega$ means that the antenna, at resonance, will show a perfect 1:1 SWR with 52Ω coaxial feed. We might add a system of 100 radials, each ½ wavelength long, to this antenna and reduce R_L virtually to zero; then $R_T = 37\Omega$ and the efficiency would be 100 percent, but the SWR would rise to 52/37 or 1.4:1. The extra loss caused by the imperfect match on the feedline would be less than the minimum loss detectable, even if the listener were expecting it. But the loss caused by an efficiency of 71 percent as compared with 100 percent would be 1.5 dB, a quite noticeable amount.

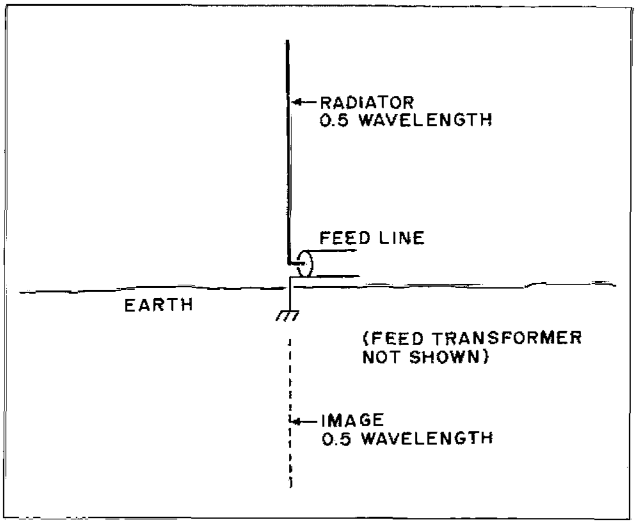


Figure 3. A half-wave vertical antenna without radials, assuming fair-to-good earth conductivity. You need to install radials on this system if the ground conducts poorly.

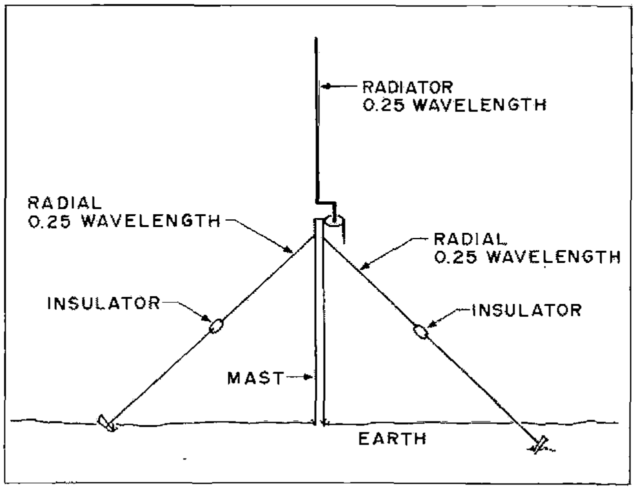


Figure 4. Ground-plane antenna in which the radials do double duty as guy wires. There should be at least three of them.

Suppose now we put a half-wavelength radiator in place of the quarter-wavelength, and install a matching transformer for the feedline. The radiation resistance of this radiator will be very high, probably at least 600Ω and most likely even more than that. If the loss resistance is still 15Ω and we assume $R_R = 600$, then:

$$\mathrm{Eff}(\%) = 100(600/600 + 15)) = 100(600/615) = 96 \text{ percent}$$

By installing the radials, we gain only 0.2 dB or so—not perceptible even if the listener were expecting it.

The above shows that a good ground isn't critical for half-wave radiators, but is very desirable for quarter-waves, for improving antenna radiation efficiency.

Ground Planes

A good ground plane is desirable for any vertical radiator because of the reflected image it provides. This "image antenna" produces low-angle omnidirectional gain, especially for a half-wave antenna. In this case the "image antenna" and the actual antenna act like a 2-element collinear array, producing 3 dB power gain over a half-wave radiator working against poorly conducting ground (Figure 3).

The term "effective ground" refers to the physical location of the radio-frequency ground plane. With perfectly conducting ground this would of course be the surface of the Earth in the vicinity of the antenna. If a vertical antenna has an extensive system of radials, then the effective ground is the surface (a plane or cone, usually) described by the web of radials.

For a ground-mounted antenna fed at the base or anywhere else along its height, consider the surface of the Earth as the effective ground location, disregarding minor irregularities, even though the conductivity of the ground may be poor. The primary difference between poorly conducting ground and a surface with near-perfect conductivity is in the loss resistance and in the ability (or lack of ability) of the ground to provide a mirror image of the antenna for gain purposes.

A radial system for efficiency is necessary in the case of a quarter-wave antenna, and for omnidirectional gain in the case of a half-wave antenna. Installing ground radials is *mandatory* for ¼-wave efficiency if the soil

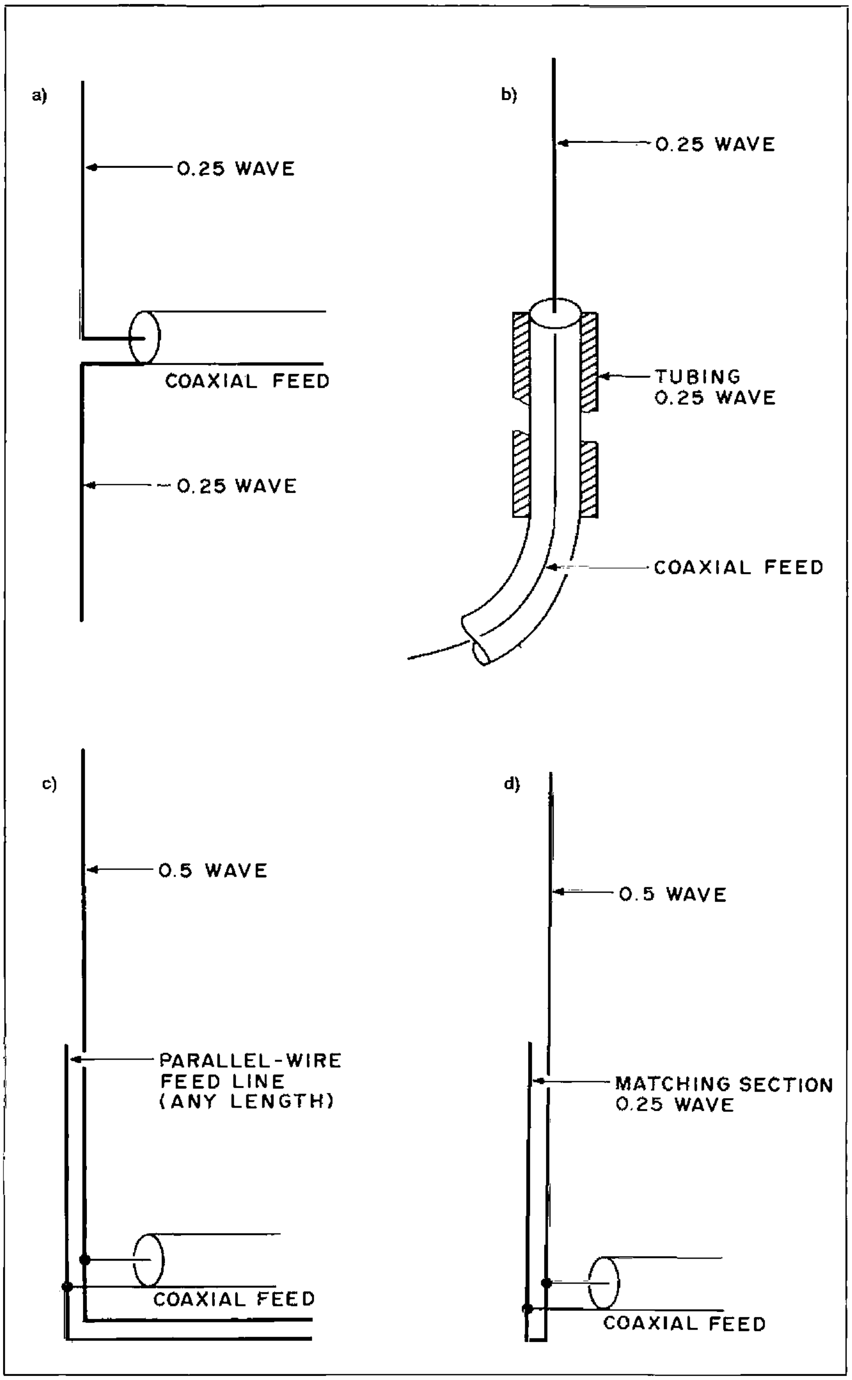


Figure 5. Four radial-less vertical antenna systems: (a) a center-fed vertical dipole; (b) the feedline runs up through the center of the lower tube section of the vertical dipole; (c) a vertical Zepp, the half-wave fed with open-wire line; (d) a variation of the Zepp, commonly known as the J-pole.

poorly conducts. They are still more critical for inductively loaded (short) verticals.

Radial Systems

How many radials does a ground-mounted antenna require? This depends on the type of soil and the available space for installing the radials. Broadcast stations on the standard AM band use upwards of 100 radials, all ½ wavelength. As a rule, at least four ¼-wavelength radials are standard for a quarter-wave ground-mounted vertical antenna, and at least four ½ electrical wavelength for a half-wave vertical antenna. Get them at least as close to that as possible. To a point, you can make up for radial shortness by adding more of them.

It doesn't matter from an electrical standpoint if the radials are buried or laid on the surface or even strung a few feet above the surface. Nor does it matter if the wires are insulated or bare.

Sometimes radial systems are designed for multiband quarter-wave vertical antennas, in which two or more radials are installed for each band. With a ground-mounted antenna this is a misconception—the more the merrier, and make them all at least ¼ wavelength and preferably ½ wavelength for the lowest frequency used.

The Above Ground-Plane Antenna

A vertical antenna does not have to be mounted at ground level. In fact, there are advantages to mounting a ¼-wave vertical well above the surface. If such an antenna is at least ¼ electrical wavelength above the ground, just two or three radials allow good radiation efficiency. Guy wires may double as radials in this installation (see Figure 4).

Cut the radials at ¼ wavelength at the operating band. For multiband antennas, as above, install at least two radials for each band, and space them apart (ideally) equally around a circle. The best slant angle for these radials is 45 degrees, as this gives a feedpoint impedance of nearly 52Ω, providing a good match to most common coaxial cable.

For ground-plane antennas installed less than ¼ wavelength above the ground at the lowest frequency used, add four radials for those bands at which the height of the feedpoint is less than ¼ wavelength, eight at ⅛ wavelength, and so on. In other words, add "n" radials for the band that is less than "1/n" wavelength above the ground. This will give near 100 percent efficiency for a quarter-wave vertical antenna at all operating frequencies.

If a half-wave vertical antenna is placed above the surface, the radials should be resonant at ½ wavelength. The height above ground is not too important, but try to make it at least ¼ wavelength. Use at least two radials for this arrangement.

Vertical Antennas Without Radials

For an end-fed, quarter-wave conductor to work well in most situations, you need radials. Some configurations, however, don't require them. Figure 5 gives four such examples.

At (a), a half-wave dipole is simply turned on its end. The feedline, either balanced or unbalanced, comes away at a right angle to the antenna—that is, horizontally—for a distance of ¼ wavelength or more. If you use open-wire, low-loss line, you may operate this antenna on all bands that are integral multiples of the frequency at which the antenna is ½ wavelength, and obtain resonance. With a wide-range tuner, this antenna loads on all frequencies down to that at which the whole antenna is ¼ wavelength.

At (b), a half-wave antenna is fed by running coaxial cable up inside the lower ¼-wave section. The outer conductor of the feed cable connects to the lower "sleeve" and the inner conductor connects to the top section. This is essentially a ground-plane antenna with the radials folded down into a vertical cylinder that completely surrounds the feed cable. It presents a feedpoint impedance of about 70Ω at the frequency where the whole radiator is ½ wavelength.

Continued on page 46

Safari Special

Get on 20–10 meters with this portable, inexpensive, and easy to build vertical dipole.

by Jay Latham N4UQT

Do-it-yourself antenna projects are technically and financially feasible for most hams—they're the mainstay of amateur construction. Here's a simple 10 meter vertical dipole that started as an illustration in Doug DeMaw's *W1FB's Antenna Notebook*. The vertical dipole, an ordinary dipole whose elements are oriented vertically rather than horizontally, does not need a ground screen, but it's physically twice the height of a quarter-wavelength vertical antenna.

I needed an easily transportable 10 meter antenna that could be erected quickly in any location. Horizontal dipoles and other wire antennas are fine if sufficient space and tall trees are available as supports. But, if you don't know what the terrain is going to look like, you need a "put up anywhere" antenna.

W1FB's Antenna Notebook example shows wire dipole elements attached through standoff insulators along a 16′ long, pressure treated 2″ x 4″ stud. The idea is straightforward and the antenna is easy to build, but it's rather heavy, and in my opinion has little eye appeal. In spite of that, it obviously fits the bill for Field Day. With this in mind, I set off to the local hardware store to gather materials for my version of the vertical dipole—the Safari Special.

Birth of the Safari Special

Hardware stores have always been a source of inspiration for me. Many of my roughly-conceived construction projects took definite shape as a result of the many components and materials on the store shelves.

I found what I needed in the corner of the stockroom: 8′ long sections of 1″ OD aluminum tubing, just waiting to be fashioned into a 10 meter antenna! The rest of the project came to me as I carried the tubing toward the checkout counter. Why not slide the tubing over ⅞″ wooden dowels, making the antenna virtually self-supporting? I bought two dowels, one for the center support of the upper and lower elements, and the other as an insulating base support for the entire antenna.

Feedpoint of the Safari Special vertical dipole. The wooden dowel has been painted to protect it from the weather.

Easy Tear Down/Put Up

The dowels are 3′ long, fit neatly into the aluminum tubing, and are easily removed for disassembly and transportation. Sand the dowels and spray them with acrylic enamel or some other nonconductive waterproofing material before final assembly, to prevent the wood from swelling and becoming stuck in the tubing. I also plug the open end of the upper element to keep water out.

Slip the aluminum elements onto the center dowel to a depth of approximately one foot, on each end of the dowel. This one-foot separation between the upper and lower elements provides enough space between the legs of the dipole to adjust the antenna to resonance before attaching the coax connector.

To tune the antenna to resonance, slide the dipole elements closer together or farther apart until you achieve a minimum SWR. Once you achieve resonance, secure the aluminum elements to the dowels with ½″ long No. 3 wood screws, right through the metal and into the wood.

The remaining hardware includes two 9″ lengths of No. 6 bare copper wire for connecting the antenna elements to the coax connector, 1-½″ stainless steel hose clamps to hold the copper wire tightly to the elements, and a simple bracket (made from a ceiling light fixture) to serve as a mount for the coax connector.

On Safari

I mounted the first Safari Special at my QTH with an inexpensive chimney mount. A second Special was attached to the top of an 8′ high, free standing 4″ square post in a friend's backyard. In other locations (where there aren't any chimneys, pipes, or posts), I set up the antenna in the sand, dirt or rocks, and guyed it at center with heavy duty

monofilament fishing line.

If possible, bring the feedline away from the antenna at a right angle for at least one wavelength. This is supposed to help prevent the coax from distorting the antenna's omnidirectional radiation pattern. (I have noticed no performance problems, however, with bringing the coax off at angles somewhat less than 90 degrees.)

I built the first Special while still a Novice operating solely on 10 meters, over a year ago. I was delighted to find out, now that I have the General ticket, that a Versatuner 901-B allows me to use the antenna on all bands 20 through 10, and I have the log entries to prove it! Entries include contacts with Japan, Alaska, Sweden, Brazil, Yugoslavia, Guyana, and many spots in between. Some of my buddies have called it the world's ugliest ham antenna, but the bottom line is: It works! I've used it with great success atop mountain ridges and on the seashore, as well as at home. This neat five-bander (20, 17, 15, 12, and 10 meters) is easy to transport by auto or boat, and takes little time to assemble and put on the air. It's also inexpensive—you can build it from readily available hardware for about $20. 73

Readers may reach the author at: Jay Latham N4UQT, Sequence Chairman, Broadcasting, College of Journalism and Mass Communications, University of South Carolina, Columbia SC 29208.

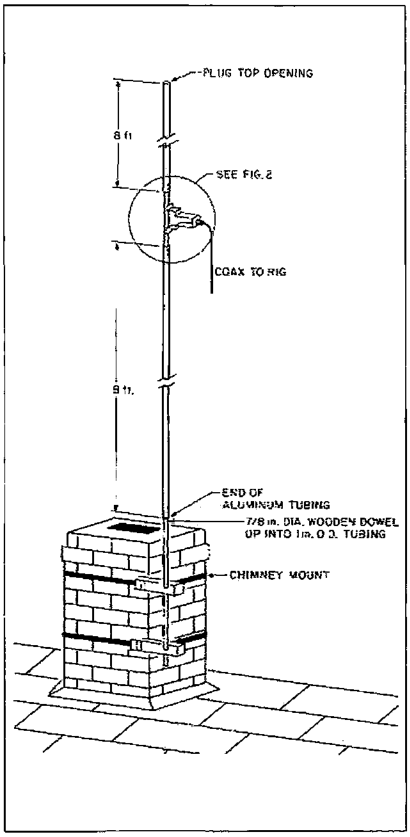


Figure 1. The Safari Special, mounted on a chimney.

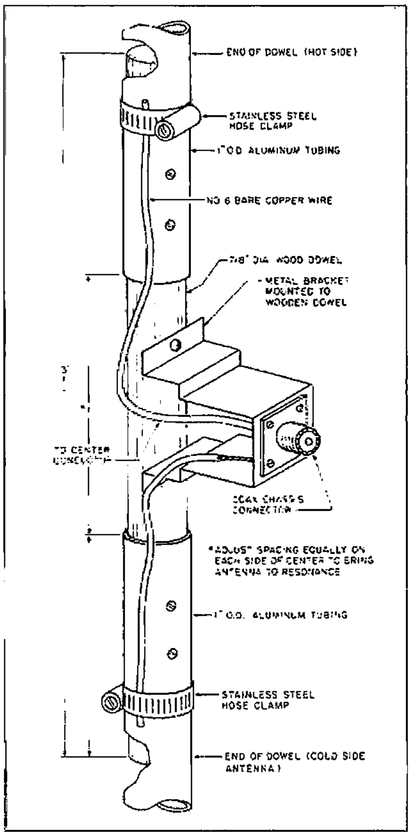


Figure 2. Close-up of the Safari Special center portion, showing connection details.

Continued from page 42

At (c), a half-wavelength radiator is end-fed using a collinear length of open-wire line or "twin lead." A tuner must be at the transmitter end of the line. This antenna is in fact a Zeppelin or "zepp" stood on end. Cut the vertical radiator to as close to ½ wavelength of the operating frequency as possible. Ideally, bring the feedline away collinearly with the radiator for at least ¼ wavelength, in order to minimize feedline radiation.

At (d), you find an alternative method of feeding the vertical "zepp." The stub of parallel-wire line is ¼ electrical wavelength. The lower end is short-circuited, and a coaxial line connects about 1.6 of the way up from the bottom. Adjust the exact tap point for the lowest SWR on the coaxial line at the desired operating frequency. This antenna is sometimes called a J-pole because of its shape.

Again, though, radials enhance the operation of even these antennas. Add them at the bottom end of the half-wave or ⅝-wave radiating section, and you'll realize a gain of about 3 dB at low angles (that is, in the horizontal plane) in all directions, as compared to any of these antennas operated over poorly conducting soil with no radials. This doesn't affect the antenna's efficiency, just the principal radiation angle, due to the phase addition of the signal from the actual radiator and its image, reflected by the ground plane. The 3 dB gain is derived at the expense of power radiated at higher angles.

There's More to It than 1:1 SWR

Shorter radiators are often used at 80 and 160 meters with inductive loading. The main problem with short radiators is in getting high efficiency. The radiation resistance drops very quickly as a radiator becomes shorter than ¼ wavelength.

¼ Wavelength Vertical Antenna Heights

Frequency (MHz)	Height (feet)	Height (meters)
1.800	128	38.9
2.000	115	35.1
3.500	65.7	20.0
4.000	57.5	17.5
7.000	32.9	10.0
7.300	31.5	9.60
10.100	22.8	6.94
14.000	16.4	5.01
21.000	11.0	3.34
28.000	8.21	2.50
29.700	7.74	2.36

For example, at 160 meters, a 26-foot vertical is 0.05 wavelength electrically, or 18 degrees of phase. Interpolating Figure 2b, we find the radiation resistance to be about 1.5Ω. This holds true no matter how much wire there is in the tuning or loading coils. If there is no loss resistance, this antenna displays a purely resistive impedance of 1.5Ω at resonance; this mandates using a matching transformer for a good SWR using 52Ω feed cable, and ground loss must be minimized by an extensive system of radials.

Suppose we build an inductively tuned short vertical of this height for 160 meters and find that the SWR is 1:1 with RG-8/U coaxial cable at 1.800 MHz. We would be delighted at our good fortune until we figure the antenna efficiency:

$$R_T = 52\Omega$$
$$R_R = 1.5\Omega$$

$$\text{Eff}(\%) = 100(1.5/52) = 2.9 \text{ percent}$$

In other words, for every 100 watts of actual power reaching the feedpoint, only 2.9 watts is radiated, while 97.1 watts is used up in heating the Earth! There is absolutely nothing we can do to increase the radiation resistance of an antenna except to make it longer physically in terms of the portion of a free-space wavelength that it spans.

Don't be discouraged from using short verticals—they work well when you optimize their efficiency via dropping the ground resistance. Recognize though that there is a limit to how short you can make a "short" radiator without some sacrifice in efficiency.

Tune in next month for Part II of this vertical antenna tutorial, where I discuss tuning coils and traps, useful bandwidth, interference, and low band DX considerations! 73

Stan Gibilisco W1GV can be reached at 871 S. Cleveland Ave., St. Paul, MN 55116.

Beefing Up the Uniden and the HTX-100

Give these popular rigs more punch.

by M. T. Stacey KC4HGH

The Uniden HR2510 and the HTX-100 have made a big splash in the amateur market. These $250–300 mobile 10 meter rigs are great performers, and fit in many of today's smaller cars. With 25 watts fed to a properly tuned antenna, it's easy to work the world, thanks to Cycle 22.

Even with the great sunspot activity, however, there are lots of other folks running much more power, and it can sometimes be tough to compete with them. I felt I needed more "oomph" to my signal.

Souping Up the Uniden

I didn't want to hook up an external amplifier, due to the severe lack of space in my sub-compact. So the rig went up on the bench for a tune-up. Although I modified the HR2510, this article also covers details on modifying the HTX-100.

I turned up the ALC, and reset the bias of the final and driver. Back to the mobile it went, with only *slightly* better results. Then I sat down with a couple of references, and decided to experiment on the RF output strip itself, since I've had good luck in this area with similar power modifications in some CB sets converted to 10 meters. Since Novices and Technicians are allowed 200 watts power out in the 10 meter voice band, it was worth a try.

In looking up the specs on the final transistor, an MRF477, you'll notice that it's rated at 40 watts PEP. If you crank the ALC all the way up and install a power mike on these rigs, you can overdrive them. Even with the stock mike, peaks can reach 55 watts. I set out to come up with a "beefier" setup for the RF output section of these radios.

The Mod

Just replacing the MRF477 with an MRF497 solves the overdrive problem, but still gives you no more power than before, so extra drive is needed. Looking "earlier" in the RF strip, you'll find a 2SC2086. Replace it with an ECG340, which provides more gain. Please note that the pinout of the ECG340 is exactly opposite of the 2SC2086!

Comparing the MRF497 to the MRF477, you will find that both have the same pinout, but the specs show the MRF497 to be a low-band FM transistor, which is rated at 40 watts RMS from 25 to 50 MHz, and is more efficient in the lower end of its range. This is ideal for hamming on 10 meters.

I tried several different transistor/driver combos, but experimentation showed the ECG340 and the MRF497 to be the best combo. The HR2510 and HTX-100 have non-tunable RF final sections, which restrict the number of useful combos.

After replacing these two transistors, and a few capacitors on the bottom of the board, and retuning/rebiasing the RF section, you will find that the rig's power out has greatly increased! Please refer to the tables for proper parts and tune-up data.

Results

All readings were taken on a power meter, using a 1 kHz test tone, with the signal fed into a dummy load. Normal voice (mine, at least) stays in the 60–65 watt range. The new PEP/Carrier ranged from 75W/11W at 28.075 MHz, to 90W/12W at 29.7 MHz.

For lower SSB power, I simply punch in the MIC GAIN button, which approximately halves the output power. The carrier power stays the same, but I suspect you could increase it to 20 watts for FM operation, with no detrimental effects. For the HTX-100, an internal adjustment and an external control governs low power output.

You might think this power modification would run into big bucks, but not so. My only investment is $25 and a little time on the bench. Best of all, I've kept it in one package!

Before the mod, using my peaked-out HR2510, I noticed the heat sink was almost too warm to touch; now, after the power mod, the heat sink only gets moderately warm, attesting to the fact that the transistors are not as stressed as before. Also, folks that knew my rig "before" and "after" have noticed the extra power punch and clean audio quality. I'm satisfied!

Resources

For proper alignment procedures, consult the service manuals for the HR2510 and the HTX-100. They will also give you the proper information in reference to parts locations, maintenance setups, etc. For the Uniden HR2510, contact Uniden Parts Dept., 9319 Castlegate Dr., Indianapolis IN 46256. For the Realistic HTX-100, contact your local Radio Shack, or Tandy National Parts, 900 North Side Dr., Fort Worth TX 76102.

For the ECG340, contact your local ECG Sylvania dealer; price is about $3.40 plus tax. The MRF497 is available through RF Parts, 1320 Grand Ave., San Marcos CA 92069, telephone (800) 854–1927 for orders *only*; price is $14.95 plus $5 shipping.

I'd like to hear from other operators experimenting with the HR2510. Good luck!

M.T. Stacey KC4HGH, PO Box 907, Satsuma AL 36572.

Uniden HR2510/Realistic HTX-100

Power Modification Parts

Procedure	HR2510	HTX-100
Relocate capacitors to bottom of board	C112, C116	C117, C118
Replace 2SC2086D transistor with ECG340; note pinouts! (See note below.)	Q134	Q34
Replace MRF477 with MRF497	Q132	Q502
Set bias of MRF497 @80-85 mA, USB	VR112	VR11
Check output of radio with meter of at least 100W and dummy load; adjust ALC to peak with 1 kHz tone	VR104	VR5 (VR6 low pwr adj)
Spread coils for maximum power	L121, L123	L14, L16
Check AM/FM carrier level and adjust	VR107	n/a
Check CW power level and adjust	VR103	VR13

Pinouts of 2SC2086D and ECG340 are exactly opposite:
2SC2086D = BCE, ECG340 = ECB.

In the HTX-100, VR5 can be adjusted for maximum power output, and with front panel control pulled out, low power can be set with VR6.

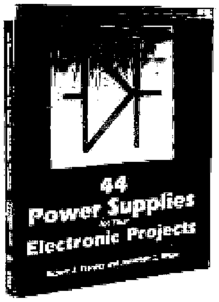
73 Book Reviews

Two Must-Adds for Your Library

Power supplies and microprocessors.

reviewed by Larry Antonuk WB9RRT

**44 Power Supplies
for Your Electronic Projects**
by Robert J. Traister and Jonathan L. Mayo
Published 1987 by TAB Books, Inc.
Blue Ridge Summit PA 17214-0850
Softbound, 7" x 9"
Price: $15.95



Just Right for Newcomers

44 Power Supplies for Your Electronic Projects is one of five new TAB books that make up the "Hobby Electronics Series." The series is specifically designed for the newcomer. Beginning books tackle basic electronics, schematic interpretations, and troubleshooting. Once the Novice has progressed through these topics, he can attempt various projects and hopefully power them with a supply from *44 Power Supplies*.

Chapter two plunges into a general discussion of power supplies. Once the operation of the supplies is covered, chapter three explains the function of each device used in a supply. Chapter four follows with a detailed explanation of voltage regulation.

Chapter five is an interesting discussion on "Obtaining and Referencing Components." This is one area that is all too often neglected. How does one come up with parts? For those readers new to the electronics scene, this short chapter will provide a wealth of information. Where do I buy parts? Where can I get them for free? How do I go about creating the famous "junk box?" (Or getting someone else's junk box for nothing!) Once I've ripped apart that old TV chassis, how do I determine what to keep? All the answers are there, perhaps never before in print!

Once all the groundwork has been laid, chapter six (about half of the book) gives the information necessary to build any of the forty-four supplies. Each project consists of a short description, a clear schematic, and advice on how to deal with any irregularities of the circuit. The circuits range from simple half-wave supplies to switching regulators. One bright spot is the inclusion of several metering "projects." Gee, I need a one amp meter, and I've got this 250 mA meter. . .how do I wind the shunt resistor?

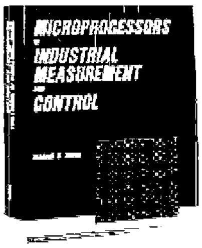
"The book is written at a basic level, perfect for the beginner. The reader is given enough electronic theory to understand the concepts explained throughout the book.

Overall, *44 Power Supplies for Your Electronic Projects* is an excellent book. A good introduction to power supplies for the Novice, and a book that is liable to find a permanent spot on the workbench bookshelf.

**Microprocessors in
Industrial Measurement and Control**
by Marvin D. Weiss
Published 1987 by TAB Books, Inc.
Blue Ridge Summit PA 17214-0850
Hardbound, 6" x 9," 436 pages
Price $44.95

Getting the Inside Story

The use of computer control in manufacturing is another of those disciplines that seems to be shrouded in mystery. Only the elite groups that actually get to work with the stuff, or maybe those folks with appropriate doctorates, *really* know what's going on. For those of us with just an abnormal interest in electronics and machines, Marvin Weiss has gone a long way toward dispersing the fog.



Starting with a discussion on manufacturing processes and measurement techniques, the book discusses various transducers and sensors. This gives the uninitiated reader a foundation in industrial processes that makes the rest of the book understandable. Various measurement systems are explained, followed by a complete history of digital automation and computerized process control. The introduction of computerized control is discussed, which leads into the microprocessor and its various applications. Complete systems are explained using microprocessors, PCs, or mainframes. The book closes with Weiss doing some crystal ball gazing on what lies down the road in the field of computer control.

The only negative point to the whole book concerns the diagrams. These are the basic low-resolution computer graphics drawings that are usually seen on yard sale announcements. I feel that this is not adequate for a book of this caliber, even if the author was using them to make a point.

The author claims some thirty-plus years in the digital systems field, which is obvious from the feeling of history one gets from the text. This makes for a simply enjoyable book. Good reading even if the user is only remotely interested in industrial control. It gives you a great introduction to the world of microprocessors, items that are quickly becoming a standard feature in all new ham gear. 73

73 Review *by T.S. Rowinski KA1MDA*

Uniden Bearcat BC100XLT Hand-Held Scanner

Uniden Corporation of America
4700 Amon Carter Blvd.
Ft. Worth TX 76155
Telephone: (317) 842-2483
Price Class: $380

Taking it to the streets. . .

My old scanner did just about everything I wanted it to do. It could not break free, however, from the all-important power outlet. If I wanted to listen in the field or on the go, the choice was simple—either get a very long extension cord, or break down and invest in a hand-held unit. I chose the latter.

After looking over the models available, I decided on the Uniden-Bearcat BC100XLT. This unit features 100 channels, 11 bands, and a rechargeable NiCd pack. It also includes a plug-in charger and protective carrying case.

The Uniden-Bearcat BC100XLT measures 2.75" wide, 8" high, 1.5" deep, weighs approximately one pound, and is finished in a dark gray plastic case. The layout is clean and sensible. Volume and squelch controls are located on top of the unit, along with the antenna and earphone connectors. The front of the unit contains the LCD display window, keyboard, and speaker. A NiCd battery pack slides onto the bottom of the radio.

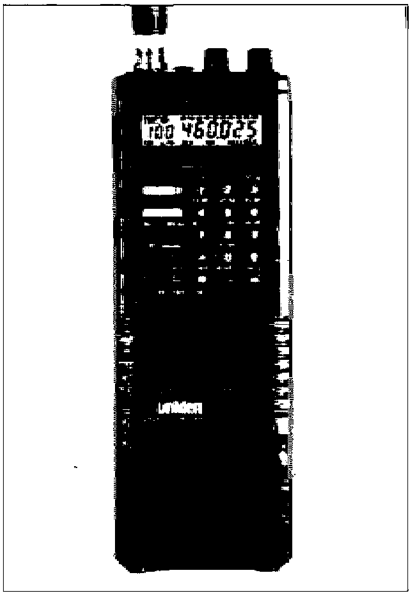
Internally, the radio is well organized and assembled, and uses mainly surface-mount technology. The LCD, CPU, and keyboard comprise one circuit board, and the entire RF circuitry is mounted on the other board. They separate easily for convenient servicing.

Coverage

The receiver covers 29–54, 118–174, and 406–512 MHz. This includes the 10m, 6m, 2m, and 70cm ham bands, as well as the VHF-LO, VHF-HI, UHF, and UHF-T bands (see table). The mode for all bands is NBFM, except for 118–136 MHz, which is AM. For ham use, this rig is especially useful for monitoring 2m and 10m FM activity.

Programming features include 100 channels arranged in 10 banks, priority channels, weather scan, frequency search, channel lockout, scan delay, key pad lock, and a low-battery indicator. The unit also sports a half-hour memory backup.

All of the controls on my unit functioned flawlessly. The volume and squelch controls operated smoothly, with just enough drag to prevent accidental rotation. The buttons on the keypad, though, are on the small side. If you have large fingers, a pencil eraser would make programming the 100 channels much easier and faster. Luckily, the most often used keys for normal operation are also the largest, so once the unit is programmed, large fingers are no problem.



The Uniden BC100XLT Bearcat scanner.

On the 22-key keypad, there are only nine double function keys, and these are the digit keys. This serves to really minimize keyboard confusion. The keys themselves are actuated by a semi-soft rubber overlay, and although the keys provide some tactile feedback, the feel was somewhat soggy. The keys are labeled with white and light gray numerals on a black background. All are easily readable in daylight, although the ones marked in gray become increasingly difficult to read as light decreases. Fortunately, the most-used keys are white.

Readout

The LCD display is simple and easy to read, even from an angle. For night viewing, the BC100XLT features an excellent display light, which evenly bathes the LCD display in a soft, green light, bright enough for viewing even from a distance. The only drawback is that the clear plastic lens covering the LCD display appeared susceptible to scratches and hazing. Readability in bright sunlight is on a par with the ICOM ØX HT series.

Although the radio itself has no belt clip, there's a belt loop on the carrying case. Congratulations to Uniden for offering a hand-held scanner with a removable NiCd battery pack as a standard feature! Being able to swap packs in the field is a great convenience. It's about time the scanner manufacturers took a hint from the ham hand-held market! Extra packs are available as accessories from Bearcat.

Programming the BC100XLT

This is very easy to program, although some of the key sequences are a little different from other scanners I've used. Memory entry is uncomplicated, requiring only memory channel <ENTER>, and then frequency dialing <ENTER>. Two minutes with the owner's manual, and operation was a snap! The scan and search functions, as well as the scan-delay and lock-out features, all work as expected. (The search function is also called programmed scan, in which a piece of spectrum between two specified bounds is scanned.)

There were even a few pleasant surprises! Should you attempt to enter a frequency into memory that has already been entered on a different channel, the radio will not only alert you of this, but also tell you the other channel number. The priority feature scans the first channel of each active bank every two seconds, providing up to 10 priority channels. Another excellent feature is the weather search function. With the push of one key, the radio scans all assigned NOAA weather frequencies. This allows for easy, up to date weather info in any area without having to tie up memory space or the normal search function. Other nice touches include one-button lockout of any channel or bank of frequencies, direct access to any channel without having to step through endless banks of frequencies, and a scan delay function that can be activated individually for each channel.

I evaluated the receiver section of the Uniden BC100XLT using two methods. First, I used the radio extensively for 10 days to form a subjective opinion of its performance. I then put the unit through its paces on the test bench to see how the numbers compared to real-world performance.

Field Evaluation

The first thing that caught my attention was the almost total absence of "birdies,"—internally generated spurs that stem from a variety of sources within the rig, such as the microprocessor, local oscillators, and mixers. Receiver sensitivity and selectivity are more than adequate, yet I never experienced front-

Continued on page 79

ABOVE AND BEYOND

VHF and Above Operation

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Six Meter Activity

Without going to "blue light" and laser topics, let's leave high microwave frequencies a bit and look at 6 meter activity. I will not forget laser activity, as I have picked up some high-power lasers, and when we've had time to experiment, I'll let you know what's going on.

The 6 meter band is the first really large frequency allocation that we have moving up frequency on the spectrum. It occupies 4 MHz, from 50 to 54 MHz. The top 2 MHz, from 52 to 54 MHz, is allocated to repeater use, with 1 MHz splits, and 52.525 is reserved for a national simplex calling frequency for FM (see the Table).

During most contests, the frequencies of prime interest are SSB on 50.100 and 50.300 MHz. Most weak signal work goes on at the lower edge, just below the 50.110 calling frequency. When the band really opens up with good F2 propagation, the entire SSB portion of the band is swamped with an unbelievable number of calling stations. During periods of poor propagation (which is most of the time), however, you can call until you're blue in the face and only get locals (maybe). Therefore, this band has beacons authorized to give you information on band quality.

Six Meter Beacons

Many 6 meter stations use beacon signals by running all the time so they won't miss a band opening when it comes. The beacon is like a bell on the end of your fishing pole to let you know when you've got a bite. The band opening during the 1959 sunspot cycle was so good it gave worldwide coverage on 6 meters in a near bedlam crunch of signals. Most people did not believe it was a VHF frequency.

The challenge on 6 meter operation comes from the time and dedication you must put into doing something that is not easily picked up or bought. It takes work, and awards, such as WAS (Worked All States), await the patient 6 meter amateur. Some people now work grid squares on this band.

Tropospheric and F2 Propagation

The normal horizon for VHF frequencies is about 300 miles, with occasional tropospheric refraction extending it to about 800 miles. Sporadic E openings are radio signals reflected off charged particles in the E layer, which is about 30 to 70 miles above the earth. The E layer gives signals a range of up to 1500 miles for a single bounce, to 2500 miles on a double bounce.

In F2 propagation, signals bounce (reflect) off a layer near the top of the ionosphere, about 200 to 300 miles up. These signals, returning, create much interest because paths of 2000 miles are common. Double-hop paths can be as long as 10,000 miles with very good signal quality.

This season promises to be one of the best on this interesting frequency band in many years. That makes getting your 6 meter equipment dusted off and back in operating shape a prime goal, as I am presently doing. The predictions point to propagation as good as that in 1959, which was absolutely outstanding.

Switching Circuit —6 Meter Preamp

The equipment for 6 meter operation at my station is an ICOM IC-551 10W transceiver and a 4-element beam antenna about 15 feet above roof level. Though modest by some comparisons, it has performed well. I would have liked the higher power IC-551D 80W transceiver, but I couldn't swing the deal at the time. In building up the station, I tried various preamps and even built my own high power amplifier. In switching the units together with my transceiver, I found the switching circuit to be rather "bulletproof."

This preamplifier, a basic design, uses a 5W dissipation high-power 2N5109 transistor, normally used in cable TV amplifiers. These are nearly burnout proof. The 2N5109 gave a measured noise figure of less than 1.8 dB, more than adequate for 6 meter activity.

I found that the more sensitive devices, like GaAsFETs, are prone to relay switching problems and rear-end blowout when you try to push your transmitter through the receive device for a few milliseconds during the receive/transmit change-over. In a radio like the ICOM IC-551, pin diodes do the switching internally, and this is fast compared to relay switching schemes. My transceiver didn't allow power amplifier switching, so I came up with this simple switching circuit to control my home-brew final amplifier.

Fortunately, the IC-551 has RCA connectors on the back for hooking up the pre-amp to the radio's internal switching circuitry. This simplified things; I only needed an external circuit to key the power amplifier on transmit. I did not want to use a power detect circuit, or "tranx circuit," as they are called. I wanted a positive control circuit, and I came up with a good one (see Figure 1).

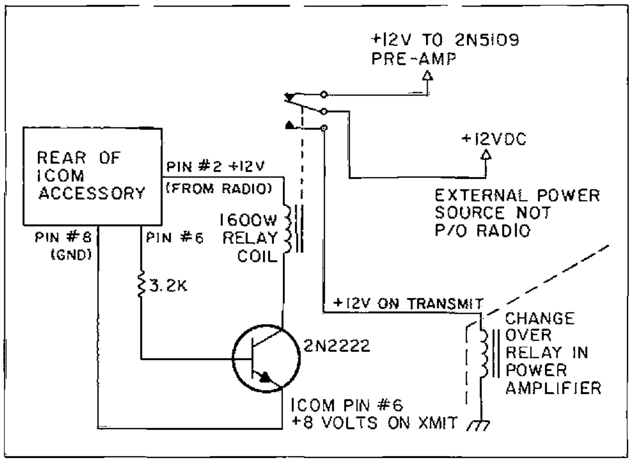

Figure 1. Circuit to control power amplifier switching with the IC-551.

You can use this circuit on any other radio with a positive voltage on transmit, to turn on the 2N2222 transistor which activates the relay in its collector circuit. In receive or off, the line (base of transistor in Figure 1) is pulled to ground. The purpose of the isolation relay is to protect the radio and give a contact for keying of external control high current relay. If for some reason there is a failure in the switching circuit, the only thing that will happen is that the power amplifier will fail to key, allowing the transceiver's own reduced drive level (about 2–4 watts) to flow to the antenna through the non-operated change-over switch.

The ICOM IC-551 rear connector has all the pinouts you need for control. You don't have to go into the radio and make modifications. According to the ICOM manual, the control voltage available on pin 6 of my ICOM is limited to 5 mA. Check your manual to determine what your limits could be, if any. To limit the current to 2 mA, I used an external resistor of 3.2k in addition to the internal 470Ω re-

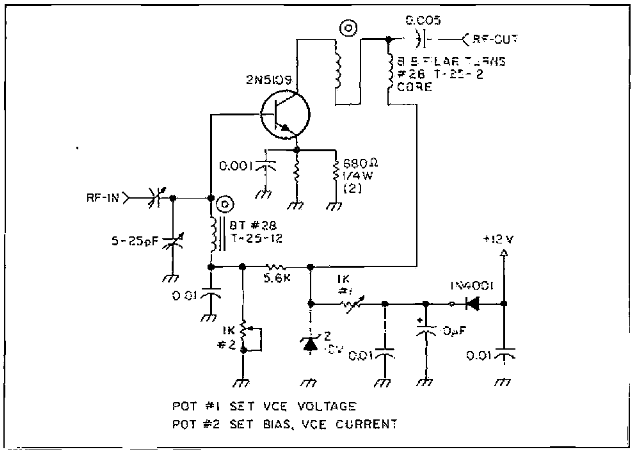

Figure 2. Preamplifier circuit for the 6m station described above.

sistor in the radio. This protects the radio circuitry from overcurrent at all cost, a good design point. The switch proved to be very reliable in many years of use.

Figure 2 shows the 6 meter preamp circuit, which I built in a small homemade PC board box for shielding. The transistor was placed in the center with a PC board partition separating the input and the output circuitry.

6 Meter Power Amplifier

See Figure 3 for the power amplifier and bias circuit. The power amplifier was constructed with a surplus transistor marked A50-12, an offshoot from one of the CB power amplifier crazes several years ago. Motorola lists an excellent replacement, MRF-492 (70 W 50 MHz), equivalent to the A70-12. The layout is straightforward; I mounted all parts on a printed circuit board, cutting the copper to form small squares or pads for mounting the components. The amplifier is operated in the linear mode with about 0.35 to 0.4 volts of forward bias supplied to the base of the transistor.

The bias circuit, comprised of a voltage divider made up of two 1Ω resistors, is simple. We limit current to a forward biased power rectifier with a 150Ω resistor, and take the resulting forward voltage drop of about 0.7 volts and apply it to the two 1Ω voltage dividers. This gives about 0.35 volts at the junction for the transistor base circuit.

I used ceramic trimmer ARCO 429 type capacitors, although any high capacitance, high current type will work well. The ARCO 429 capacitor is variable; it measured 100 to 450 pF on my capacity meter. When tuning the power amplifier up, check the bias to prevent the transistor from running away with excess current (not over 0.5 volts) on the base. At about 0.7 volts, you will turn on the transistor fully, and you want to avoid excess current!

When all tested OK, I applied 12 volts to the collector and drive to the input of the amp. Adjusting the capacitors for best SWR on the input drive was about 2.5 watts for full output use, reduced drive for initial tests. You should adjust the output capacitors for maximum output. I had to reduce the length or size of the turn on the coil input and output to properly match impedances, in order to achieve maximum output. Don't let the device become overly dissipated; use short key-up times. The antenna change-over is a modified standard DC type 12 relay modified for RF use (see Figure 4).

Six Meter Band Allocations

Frequency (MHz)	Usage
50.000–50.100	CW and Beacons
50.060–50.080	Automatically Controlled Beacons
50.100–50.600	SSB and AM
50.110	SSB DX Calling Frequency
50.200	SSB National Calling Frequency
50.400	AM Calling Frequency
50.600–51.000	Experimental and Special Modes
50.700	RTTY Calling Frequency
50.800–50.980	Radio Control (10 channels)
51.000–51.100	Pacific DX Window
51.100–52.000	FM Simplex
52.000–52.050	Pacific DX Window
52.000–54.000	FM Repeater and Simplex

From the Mailbox

Gary KE6CZ asks whether the Grid Square program is suitable for distances greater than local (USA) coordinates. On his Tandy 102, the program gives incorrect compass headings and erroneous nonlocal distances. Could there be a program error in calculating the compass headings? The mileages/distance came out fine for distances of up to 200 miles, but with longer distances, the errors increased.

On my Tandy 100 and a Kaypro computer, I tried the locations Gary was having trouble with, but they all came out properly. Data entry errors or something special to the Tandy 102 could be the problem. If any of you have information on the Tandy 102 with the

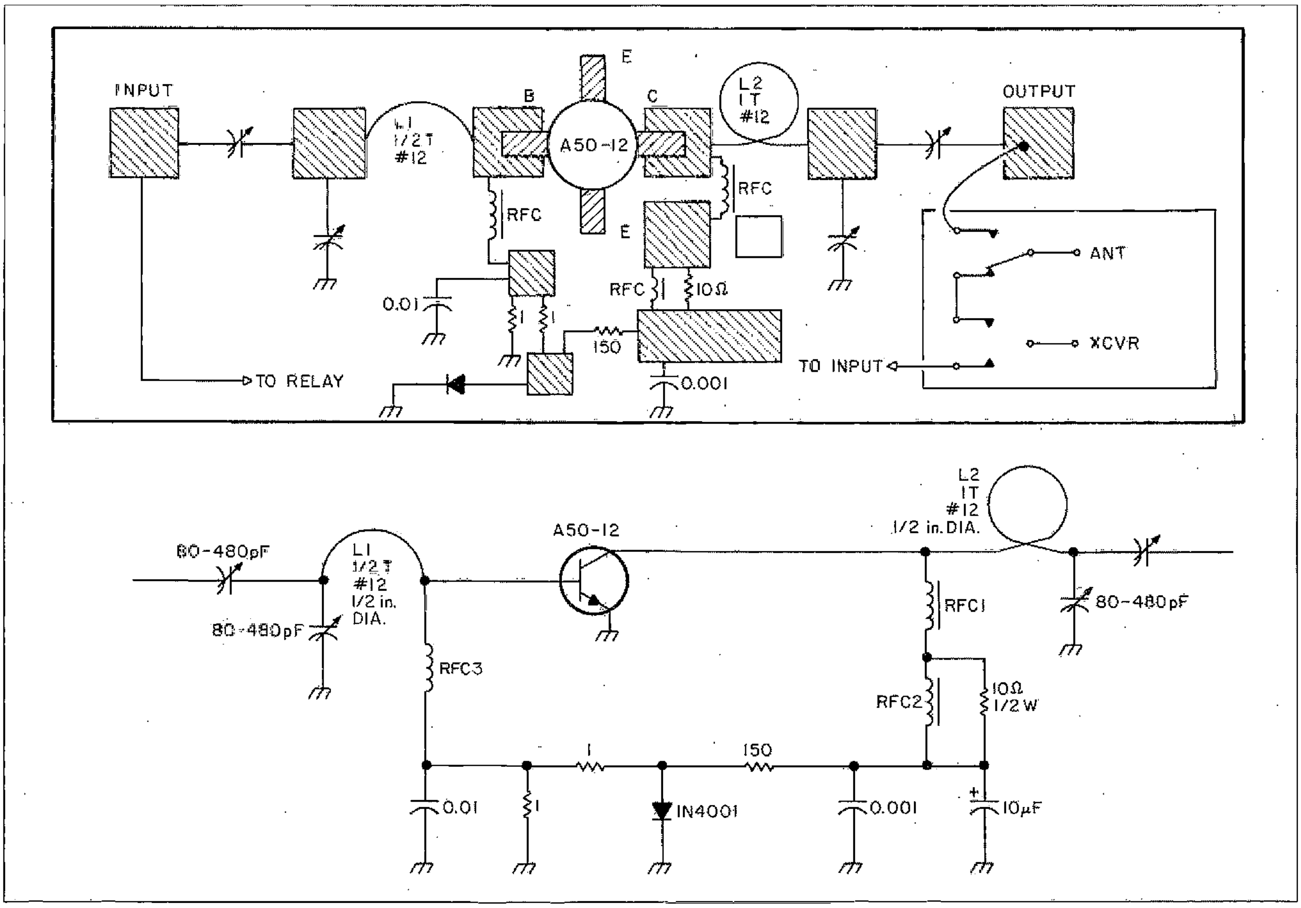

Figure 3. Power amplifier and bias circuit.

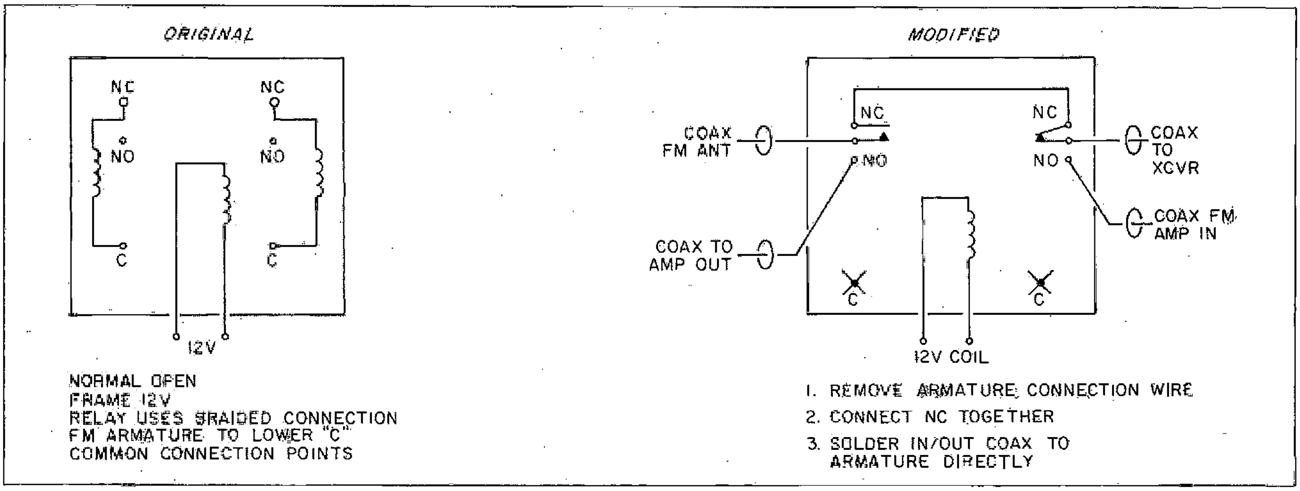

Figure 4. Antenna change-over circuit.

Grid Square program, let me know. Bruce KB4ZAX states he has it up and running on his Tandy 100, and he's eager to locate other programs he can use. He would especially like to find a logging program with a search feature for contest and Field Day operations.

Larry K1LPS is keeping me informed of activities in his neck of the woods in Vermont. Larry is quite active, presently working on several projects to use on bands up to 10 GHz, such as parobolic dishes for 2304/3456 MHz. He's also trying his hand at 10 GHz toward Canada, with Michael VE2DUB in Montreal from his 3300 foot location. VE2DUB is organizing 10 GHz activity in the Montreal area, and he should have a beacon up for testing 10 GHz equipment. Michael has an 18-inch dish, roof-mounted, with a penny feed. It's perforated to minimize wind loading.

By the way, shipping ham items to Canada can result in quite a tariff tax to the receiving party. But if the item is specified as an amateur transmitter or receiver, with the appropriate tariff number, such as 8525.39.10, which is a catch-all number, you can send the items duty free, incurring only local sales tax. You should obtain the tariff number that applies to your item.

Solfan News

It seems that many amateurs are having trouble locating 10 GHz Solfan microwave alarm devices. Recently, I received a letter from SHF Microwave Parts, 7102 W. 500, S. La Porte, Indiana 46350, informing me that they have a quantity of Solfan style units and other parts for 10 GHz operation available. Write for details.

Let me know what's happening in your area. I will be operating in the ARRL 10 GHz contest again this year, and I hope to see you there or on 6m. As always, I will be willing to answer questions relating to amateur microwave VHF/UHF. Please include an SASE for a prompt reply. 73

HOMING IN

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RDFing— A Growing Sport

In recent months, the mail has brought letters and phone calls about RDFing from all over the USA, Hawaii to Maine, Canada, Malaysia, Italy, Iran, Sweden, and Brazil. I've had the pleasure of giving talks on ham RDF to about twenty clubs, and telling about it on a nationwide radio show. New hunt groups are forming constantly, and they're having a great time.

Homing In would like to hear about your hunts, too. So help fill my mailbox even more. Include an SASE, and I'll send you a bibliography of recent books and articles related to transmitter hunting.

What's a TDOA?

Until now, I've discussed only single-antenna RDF systems, such as yagis, quads, and loops. They're great for locating weak or strong signals of just about any mode when the transmitter power is steady. But sometimes the signal amplitude isn't constant. When the S-meter is bouncing around so much that you can't tell when you're pointing the beam or quad at the signal source, you know it's time for a different kind of RDF system.

Over the years, a number of RDF schemes evolved that ignore the ups and downs of the incoming signal. They all involve the use of multiple antennas and comparisons of the signal that the hidden T puts into each one.

Switched-pattern DFs (such as the L-Per and Happy Flyer) and ring antenna units (such as Adcocks and Dopplers) are examples of well-known multiple antenna schemes. I'll cover these in future columns. This month, we'll look at a system that has a simpler principle of operation—the time-difference-of-arrival, (TDOA) antenna system.

Figure 1 shows a simple TDOA array, consisting of two vertical dipoles at the ends of a horizontal bar, supported by a short mast. It's called a narrow-aperture TDOA because the dipoles are a half wavelength or less apart. The direction of the incoming signal is determined by comparing the signals at the whips. Note that the signal from Transmitter #1 arrives at Antenna A before it arrives at Antenna B. Conversely, the signal from Transmitter #3 arrives at Antenna B before Antenna A. The signal from Transmitter #2 arrives at both antennas simultaneously.

Some sophisticated military RDF systems use this TDOA principle to get highly accurate bearings at fixed-site radio direction finding (RDF) installations for the HF bands. Even the elevation angle of arrival above the horizon can be determined, giving an idea of the distance of skip-propagated signals. But resolving ambiguities, determining elevation, and achieving high accuracy in a non-rotating system requires at least three antennas and a large, fast computer for signal processing. We're talking megabucks, so that's not practical for ham radio use, at least not yet.

But there's a well-known characteristic of FM detectors that makes the rotatable TDOA array of Figure 1 a useful tool for VHF ham radio T-hunting with very simple signal processing. Feed the two antenna coaxes to an FM receiver through a selector switch, and then toggle that switch between the two antennas very rapidly, say 500 times per second. If the signals aren't arriving at both antennas at exactly the same time, there's an abrupt phase jump during switching, which the FM discriminator interprets as a frequency change.

Antenna switching occurs at an audio rate, so the apparent frequency change produces a superimposed tone on the received audio. The tone frequency remains constant at the switching rate, but the tone amplitude increases with the increasing phase difference between the signals arriving at the two antennas. The goal is to get a tone of minimum amplitude; this occurs when the antennas are equidistant from the signal source. At this point, the tone should disappear altogether. Other null patterns are possible using delay lines in individual antenna paths.

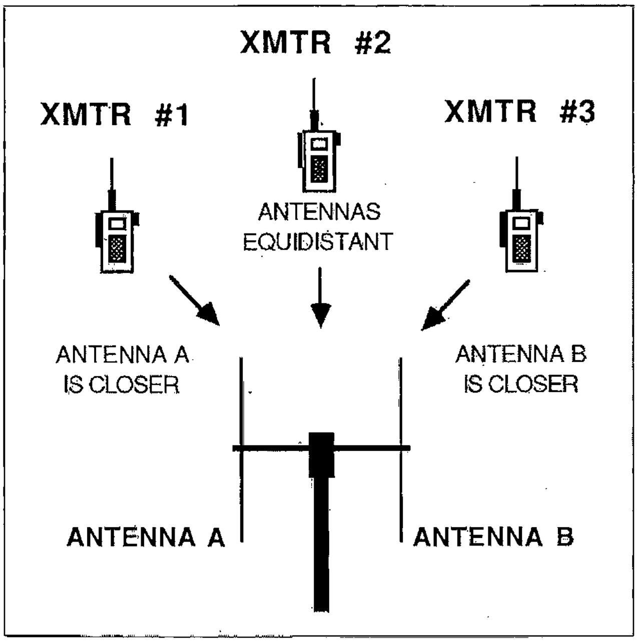

Figure 1. A TDOA RDF system tells direction by determining which of its antennas is closest to the transmitter.

Build the "Handy Tracker"

Photo A shows how simple a DF set like this can be. This unit connects to your handy-talkie or scanner, and you rotate it by hand to take bearings. You could also mount it on a mast and use it for mobile hunting.

If you've used a loop and switchable sense antenna for direction finding on HF or VHF, you'll feel right at home with the Handy Tracker. Operation is basically the same. The difference is that a loop requires measurement of the signal strength, which

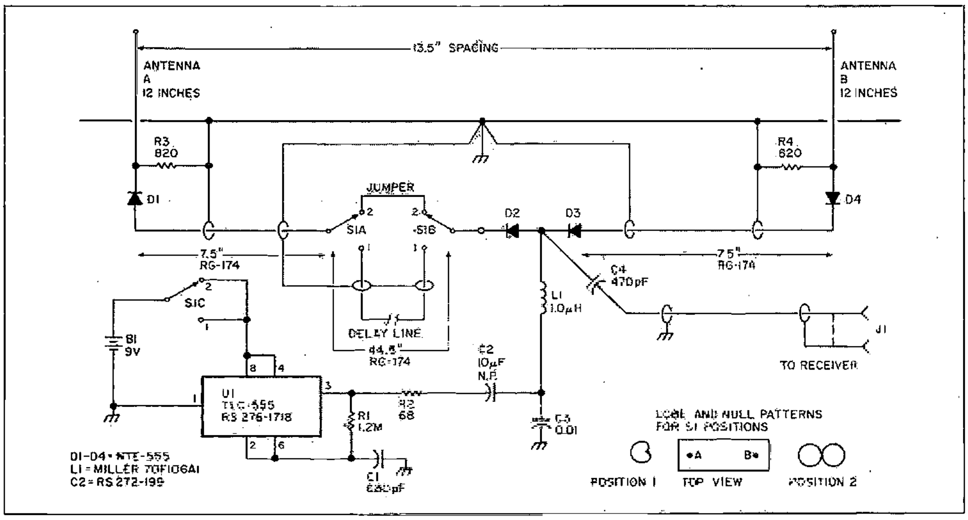

Figure 2. Schematic for the Handy Tracker. Dimensions shown here are for 2 meters. See text for replacement dimensions for 220 MHz.

The Handy Tracker. This unit uses the Time Difference of Arrival technique for accurate long distance work or close-in "sniffing" RDFing.

means you need an S-meter. You'll probably have overload problems with a loop when you get in close. But the Handy Tracker superimposes a DF tone onto the receiver audio, so your ear takes the place of the S-meter. There are no overload problems because it uses phase, not amplitude, to detect the received signal direction.

The Handy Tracker uses only one IC and is very easy to build. An ordinary 9 volt alkaline battery will power it for dozens of hours. Instead of full-length dipoles, it uses a pair of short whips.

Figure 2 shows the circuit. U1, a CMOS timer, produces a square wave that is AC coupled to give both positive and negative polarity drive to the PIN type RF switching diodes. All parts are readily available and should cost no more than $15. The enclosure is double-sided, unperforated PC board material soldered together at the seams to be RF tight.

The antennas must be sturdy and rigid for good performance. I made them from 3/32-inch bronze rod, available at welding supply stores. If you want them to be detachable, use RCA, BNC, or UHF connectors at the bases. Be sure to put some sort of eye protection at the antenna tips (⅜-inch plastic beads work well) and use proper caution when DFing.

Use RG-174 miniature coax for the phasing and delay lines. Coil up the excess length of the delay line inside the enclosure. You can use any convenient length of RG-58 between the unit and the receiver, as in Photo A, or you can mount a BNC connector on the bottom of the unit and use an adapter to connect it directly to your handy-talkie.

S1 is a miniature 3PDT center-off toggle switch, such as C & K #7303. One pole turns power on when the switch is thrown to either side. The other two poles select the RDF mode. In this discussion, we'll refer to the two modes as S1 positions 1 and 2.

A quarter-inch jumper connects the position 2 contacts of S1A and S1B. It's very important that the RF path length between node X (D2-D3 junction) and each antenna base be the same, including the 7½-inch coax lines, the S1 jumper, and the PIN diode leads. One-half inch difference causes about three degrees error in bearings. The leads on the node X ends of L1 and C4 must be short. Solder the shields of the delay line and the D2/D3 ends of the 7½-inch coax lines to ground inside the box at a point midway between the two antennas, as Figure 2 shows.

Tracker Operation

When you have the unit wired up, hook it to your receiver and install a fresh battery. Tune the receiver to the local repeater and set S1 to position 2 (two nulls). You should hear a distinct tone or buzz at about 500 Hertz added to the receiver audio when a signal is being received. If not, check the U1 oscillator circuit.

Do the rest of your performance checks outside, in as clear an area as possible, away from buildings and large objects. Unless you're in a very high location, do your testing with a nearby signal source, such as a friend with a hand-held rig a few hundred feet away. As you rotate the antenna system in position 2, you should find two deep nulls in the tone, 180 degrees apart. If the two nulls are not exactly 180 degrees apart, try shortening the coax line to Antenna A slightly.

Determining Signal Source Direction

On-foot sniffing is easy with your handy-talkie and the Handy Tracker. Use position 2 (two lobes and two nulls) to obtain an accurate line of bearing to the signal source. It's analogous to the figure-8 pattern of a DF loop, with very sharp nulls. Rotate the Handy Tracker for minimum tone in the received signal audio, then sight between the two antennas (perpendicular to the plane of the antennas). The signal is now either ahead of you (like Transmitter #2 in Figure 1) or behind you.

Switch over to position 1 (one lobe and one null) to determine which of the position 2 nulls is correct. Position 1 produces a cardioid (heart-shaped) pattern, much like a loop-sense system. Turn the Handy Tracker ninety degrees so that one end points along the line of bearing and note the tone level. Now rotate it 180 degrees and note the tone level. Unless you're plagued with multipath, there will be a distinct difference in levels. The minimum level occurs when Antenna B is closest to the signal source.

Note that the cardioid pattern of position 1 is not perfect. Depending on frequency and the surroundings, the null may not be so deep as to make the tone disappear, or there may be two closely spaced nulls. This isn't a problem because the only purpose of position 1 is to determine which one of the position 2 nulls points to the source. Once the unit is tweaked to give exactly 180 degrees of difference between the position 2 nulls, these nulls will be quite reliable. Use position 2 to get your accurate line of bearing.

Accidental transmissions from low-power handhelds will probably not damage the PIN diodes. But the short antennas aren't a good match for your radio, so avoid transmitting through the unit. I recommend using one watt resistors at R3 and R4, just in case your finger slips and squeezes the push-to-talk switch.

Dimensions in Figure 2 are for 2 meters. To build a set for the 220 MHz band, use 8-inch antennas spaced 8⅞ inches apart. Make the delay line 29 inches long. 73

Number 19 on your Feedback card

ASK KABOOM

The Tech Answer Man

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Grounded!

If there's one truly universal concept in electronics, it's the notion of ground. We ground our rigs and towers. Our electrical outlets have grounds. Inside our radios, the circuits are grounded to each other, usually through the metal chassis. Everything seems to need a ground. But just what is a ground, anyway??

Mother Earth

The original notion of electrical ground was THE ground. The one you walk on. In fact, British nomenclature still uses the term "earth" where we use "ground." They say that the radio is "properly earthed."

Natural electricity, such as lightning and static discharge, generally completes its circuit via the air/ground interface, that being the point of greatest physical discontinuity (solid to gas), and therefore the most likely point of strongest electrical potential difference.

The ground is the great sinkhole where electrical charges can be dumped, never to return. In the case of lightning, it can often work the other way around, with bolts leaping from the ground to meet the clouds. But the sinkhole concept is a very useful one, and we'll revisit it soon.

Like everything else in electrical science, the term "ground" has evolved to mean much more than simply "the ground." Today it refers to the common point in any circuit from which other voltage potentials are referenced.

Let's Visit the Relatives

This idea raises an apparent paradox: How can one point (ground) be positive with respect to one voltage and negative with respect to another AT THE SAME TIME? Surely positive is positive and negative is negative, and never the twain shall meet, right?

Nope. Like almost everything else in the known physical universe, it's all relative. Imagine, for a moment, that you're in your car, doing 65 mph (relative to the ground) on the interstate. You're approaching a car doing 60 in the next lane. Coming in the opposite direction is a car doing 55. Relative to you, the opposite car is going 120 mph, and the car upon which you're gaining is only going 5 mph. But to each other, they're going 115. And if you arbitrarily pick north (your direction) as "positive," then the opposite car coming at you is negative, and so is the one you're approaching (because they're both coming at you)! From the point of view of the ground, both you and the car next to you are positive, and only the opposite car is negative.

So, negative and positive are strictly relative terms, and do not imply any absolute quantities! The same holds true of electronic circuits. Oh, sure, you've heard that negative means an excess of electrons, and positive a deficiency of them. Yes, but only in relation to each other. If point B has more electrons than point A, then point B is negative with respect to point A, even though it may be positive with respect to point C, which has still more electrons. In this case, C is negative with respect to both points A and B.

With your black ("negative") VOM lead connected to circuit ground, let's say you measure +12 volts at one point, and +8 volts at another. If you then put the black lead on the +8 volt point and check the +12 volt point, it'll read +4 volts. If you leave the black lead on the +8-volt point and try to measure ground, it'll read −8 volts.

Back to the Sinkhole

So, ground is really just the point which has been chosen to reference all other points in a circuit. But it also is assumed to possess one other quality, and this is the one which may be most relevant to us as radio amateurs.

Ground is chosen to have the lowest possible impedance with respect to the outputs of the power supply. In other words, signals come in, but they don't come out! They are routed right back to the power supply outputs (whence all signals come, after being modulated by the various active stages), and are therefore effectively shorted out, having completed their circuits. That is the function of the 0.1, 0.01 and 0.001 mF caps you see around most power supply connections to RF circuits.

That's why signals bypassed to ground don't show up in other stages. When that very low impedance is missing, circuits start oscillating, due to their own, or other, unwanted signals feeding back through power inputs. The old term for it was "motorboating," because of the characteristic sound in audio circuits. An open bypass capacitor was invariably the culprit.

DC, AC and RF Grounds

A capacitor can provide a good AC or RF ground connection because AC signals will effectively pass through it. DC will, of course, be blocked by the cap, so the impedance at DC will be infinity, like an open connection. Similarly, an inductor (coil or choke) can be used to ground DC, while blocking AC. These techniques are very commonly used in circuit designs, and provide powerful tools for manipulating signals.

> ***"The original notion of electrical ground was THE ground."***

The type of ground that gives us hams the most grief is the RF ground. Why is it different from other types? It's basically an AC ground, but it has the distinction of requiring a low impedance at rather high frequencies, and that is easier said than done.

The higher in frequency you go, the more a given amount of inductance will impede a signal. Thus, the higher you go, the shorter a length of wire or other conductor needs to be for its inductance to become significant. That's why coils for 2 meters are far smaller than those for 75 meters!

Imagine a graph of a sine wave 75 meters (about 225 feet) long. Any two points only, say, 12 inches apart, will have very little change in the wave, or voltage potential, between them. If, however, the wave is only 20 inches long, then 12 inches represents a great deal of change.

At 3.730 MHz, two points 12 inches apart on a metal chassis will be at the same potential because the wavelength is so long that, as a percentage of it, 12 inches is insignificant. At microwaves, though, those points may be SEVERAL WAVELENGTHS apart, and may have very different voltages on them. Thus, they will not truly be connected to each other, even though they are connected to the same piece of metal! If that chassis is meant to be a common ground, some serious problems will result.

Grounding Your Station

For your station to operate at its best, it should be well-grounded with respect to the earth, at the highest frequency you use. Why? The reasons are varied. For one thing, RF in the air reflects, or "works against" ground, and grounding the radio helps complete the circuit and prevent feedback, as in the motorboating example. This is especially true with unbalanced antennas such as long-wires, which have no counterpoise to complete the circuit, and thus work poorly unless the earth is coupled into the circuit via the station ground.

Also, any natural discharges, such as nearby lightning, will hopefully be coupled to ground through the low-impedance ground path instead of through YOU to ground. By the way, actual lightning is not required—I've seen half-inch sparks between the antenna terminals of a 40 meter dipole, just from unsettled weather's causing a potential difference between the dipole's legs!

The best method for creating an effective station ground is to use wide wire braid, as short as possible, to several long rods driven into the ground near your station. As long as the braid is shorter than ¼-wavelength of your highest operating frequency, this arrangement should do the job. The width of the braid matters because of the "skin effect," whereby high-frequency signals tend to travel near the surface of a conductor. A regular piece of wire just doesn't have enough surface area, making its apparent impedance go way up.

Alternatives

Unfortunately, many of us live in locations which make such a ground impossible. A cold-water pipe can sometimes be a decent ground, but only if it's connected to the earth. Some newer systems use sections of plastic piping and so are actually not grounded! The ground pin of an electrical outlet is

also usable, but remember, it is meant to be grounded at 60 Hz, and may be many wavelengths long at 10 meters. If you live in an apartment several stories up, a piece of wire thrown out the window can simulate RF ground by acting as a counterpoise against the antenna's radiator. This will work best when the wire is tuned to the operating frequency and, of course, won't provide any protection against natural discharges.

In a previous column, I mentioned the coaxial ground. Actually, it's a coaxial ground CONNECTION method, and still requires a ground at the other end, but it can really help when the ground is just too far away. If anybody needs it and can't find the column, let me know and I'll describe it again.

In any alternative situation, safety must come first. It is possible to create a shock hazard in a cold-water pipe if the pipe is long enough that there are nodes in the wave traveling down it toward ground. In this case, it may provide a poor ground anyway. Also, using an outlet's ground pin invites TVI by distributing RF to everything plugged into the system.

It's true that many aspects of ground remain unexplained. Nonetheless, there is also a lot of sense to it, some of which I hope I revealed to you here.

Now, let's look at a letter:

Dear Kaboom,

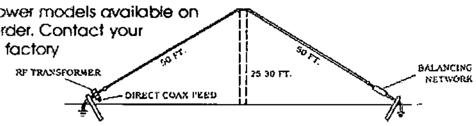
My MFJ 1270 TNC seems to work well, but the DCD light flickers even when there's no signal, and it interferes with proper operation. If I turn my computer off, it goes away! Is there any way to eliminate that false indication?

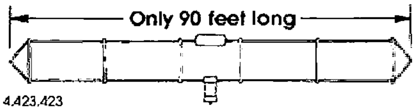
Signed,
Blinkin' Out

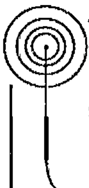
Dear Blinkin'

Sounds like computer hash getting into the RADIO (not the TNC) is causing some spikes to be input to the TNC, fooling it into thinking there's a packet carrier. Try using shielded cable and/or wrapping it through a toroid, right at the radio where the speaker signal exits to the TNC. That should isolate the rig from all those fast computer pulses. Also, is your RS-232 cable shielded? If not, try a toroid there (at the TNC) too.

Have a question? Send it to "Dear Kaboom" at the above address. 73







HAMSATS

Amateur Radio Via Satellite

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New Satellites on the Way

Microsat information and data on the new University of Surrey spacecraft has been hard to avoid. Articles in the major amateur publications have covered these new satellite hopefuls quite well. Check the May issue of *73* if you somehow missed the media blitz.

Launch is scheduled for November from French Guiana on an Ariane rocket. Four Microsats and two UoSATs will be on board with the French SPOT 2 satellite. It's easy to forget satellite programs in different parts of the world with so much attention focused on projects such as packet hamsats from AMSAT North America and AMSAT Argentina, the 2 meter voice synthesizer from AMSAT Brazil, the CCD camera experiment from Weber State College, and the advanced educational UoSATs. Other hamsats are under consideration, construction, or are scheduled to be in orbit soon.

Russian Hamsats

RS-12/13 was scheduled for launch this year, mounted on a Soviet COSMOS navigational satellite. Like the RS-10/11 pair sent to orbit a few years ago, the new transponder system was designed to have transponders for Mode A (2 meters up and 10 meters down), Mode K (15 meters up and 10 meters down), and Mode T (15 meters up and 2 meters down). It's possible there will be combined operation with Modes KA and KT, using mixed uplinks or duplicate downlinks. Check the table for preliminary details on transponder operating frequencies.

RS-12/13's orbital parameters are typical LEO (low earth orbit) with a height of 621 miles and a period (time for one orbit) of 105 minutes. Maximum transponder output is typically 8 watts spread over the downlink, while the beacons and ROBOTs can be commanded for 0.45 to 1.2 watts out. It is easy to hear the downlink signals on 2 or 10 meters at these power levels.

The auto-transponder, or ROBOT, calls CQ on either its normal frequency as shown in the table, or on the usual beacon frequency, if so commanded by a ground control station. If you hear it, listen carefully to the message. The ROBOT will give the uplink frequency it will monitor during the next quiet period. If RS-13 is active in Mode KA, an uplink frequency on 2 meters will alternate with one on 15 meters after each ROBOT calling period.

To call the ROBOT, first center your uplink carrier until it is a continuous tone on the ROBOT's downlink. Due to Doppler, the announced uplink frequency may be a few kHz off from the best uplink point. Call the ROBOT at a CW speed close to that heard. Usually 15 to 20 words per minute is best. An example sequence would be *RS13 DE WA5ZIB AR* (where *AR* is a continuous di-da-di-da-di with no spaces). Computer or keyer-generated CW is preferred since the ROBOT is also a computer and not forgiving of a poor fist.

The ROBOT will respond with a message and a contact serial number if all goes well. Copy the number and other data if a QSL from "cosmic space" is desired. Send cards to Box 88, Moscow USSR. When the ROBOT has trouble with a signal, an international "Q" signal is sent to signify speed difficulty or just interference (QRM).

> ***"Call the ROBOT at a CW speed close to that heard. Usually 15 to 20 words per minute is best."***

Japanese Hamsat

Following the trail blazed by Fuji-OSCAR-12, JAS-1b is scheduled for launch in February 1990. The new Japanese satellite will be sent up as a secondary payload with Maritime Observation Satellite MOS-1b into a sun-synchronous orbit less than a hundred miles lower than RS-12/13.

JAS-1b will pass over a given location on the earth at about the same time every day, but it will experience serious solar eclipsing. Power budget problems experienced by F-O-12 will not be as severe for the new hamsat. New high-efficiency gallium arsenide (GaAs) cells over a slightly larger frame will provide 11.5 watts of power after launch. F-O-12 started with only 6.5 watts from its silicon arrays. Although the GaAs cells provide more power, they are heavier, and break more easily.

Mission objectives call for continuous operation of the digital packet-radio Mode JD (2 meters up and 70 cm down).

The JA analog (SSB and CW) transponder operation draws an average of 5.3 watts. During periods of continuous sunlight, it may be possible early in the satellite's life to run JD and JA simultaneously. Power drain will be about 10.2 watts, just a bit below maximum solar array output.

The JD FM uplinks include 145.85/.87/.89 and /.91 MHz with a single PSK downlink frequency of 435.91 MHz. The JA analog transponder uplink is 100 kHz wide from 145.90 to 146.00 MHz. The corresponding downlink band extends from 435.90 to 435.80 MHz with a CW beacon on 435.795 MHz. The passband is inverting; lower sideband in yields upper sideband out.

Antennas on JAS-1b will use a ring-type turnstile for receiving and a second turnstile like that on F-O-12 for transmitting. The JA and JD transponders will share the downlink antenna. F-O-12 used separate downlink antennas

Photo A. Full-size model of the Phase 4 hamsat. It is being packed up at the end of the Dallas Ham-Com show, to ship back to Weber State College in Ogden, Utah.

Photo B. Bryan NS1B, 73 Magazine *Editor-in Chief, after several CW QSOs through A-O-13 at the W1AW/5 station at the National Convention in Texas. A voice and keyboard mode op, he was pleasantly surprised to discover he could still use a key!*

for the digital and analog transponders. The new hamsat requires the addition of a circulator in conjunction with phase splitters to allow for the common transmit antenna.

Even during worst-case solar conditions (33 percent eclipsing), continuous on-board computer operation will be possible. This will allow the satellite's internal housekeeping unit to have more control over the satellite's systems and function management rather than having ground stations constantly monitor system performance.

Preliminary Frequency Plan for RS-12/13
(All frequencies are in MHz)

	Transponders		RS-12/13
Mode A	Uplink	145.910–145.950	145.960–146.000
	Downlink	29.410–29.450	29.460–29.500
	Beacon	29.408	29.458
Mode K	Uplink	21.210–21.250	21.260–21.300
	Downlink	29.410–29.450	29.460–29.500
	Beacon	29.408	29.458
Mode T	Uplink	21.210–21.250	21.260–21.300
	Downlink	145.910–145.950	145.960–146.000
	Beacon	145.912	145.862
Mode KA	Uplink	21.210–21.250	21.260–21.300
		145.910–145.960	145.960–146.000
	Downlink	29.410–29.450	29.460–29.500
	Beacon	29.408	29.458
Mode KT	Uplink	21.210–21.250	21.260–21.300
	Downlink	29.410–29.450	29.460–29.500
		145.910–145.950	145.960–146.000
	Beacon	29.408	29.458
		145.912	145.862

Auto-Answer Robot RS-12/13

Modes	A, K, T, KA,K,T	A, K, T, KA, K,T
Uplinks	21.129	21.138
	145.831	145.840
Downlinks	29.454	29.504
	145.959	145.908

Dallas Ham-Com Happenings

AMSAT North America presented a full-size model of its geostationary hamsat at the American Radio Relay League National Convention in Arlington, Texas, in June. (See Photo A.) It is an awesome structure to behold at over seven feet in diameter and 30 inches tall—its size alone completely dwarfs previous hamsats. Just the simple model weighed so much that it required several volunteers to unload it from the special van necessary for its transport.

The model was built at Weber State College in Ogden, Utah by students, faculty, and volunteer engineers. AMSAT NA engineer Dick Jansson WD4FAB has documented proposed design specifications and all necessary mechanical drawings with Computer Aided Design (CAD) software.

Transponder frequencies are still under discussion. Modes involving 23 and 9 cm uplinks coupled to 70 and 13 cm downlinks are favored. These are appropriate choices for a geosynchronous hamsat. Small dish antennas could be permanently aimed at the satellite for reliable noise-free communications over a whole hemisphere.

At the convention, AMSAT Vice President Jan King W3GEY and AMSAT President Doug Loughmiller KO5I presented talks describing the Phase 4 concept and its capabilities. Input from Bob Twiggs, the director of the Center for Aerospace Technology at Weber State, emphasized the educational potential of the program. Phase 4 is a viable project and a logical progression for amateur radio if sufficient funding is available. The first flight-ready satellite of this ambitious endeavor could be ready for launch in 1994.

Other satellite-oriented activities at the convention included a complete OSCAR station for W1AW/5. Many would-be satellite enthusiasts got a chance to witness and make hamsat contacts, thanks to the complete station provided by ICOM America. Participants tracked and worked every operational amateur satellite from the special station set up just outside the convention center.

Advanced AMSAT NA tracking software automatically aimed the antenna system while enthusiasts like Bryan Hastings NS1B, *73's* Editor-in-Chief, ran some CW through the AMSAT-OSCAR-13 Mode B (70 cm up and 2 meters down) transponder. F-O-12 and RS-10 also provided excellent QSOs. 73

TECH TIPS

Pearls of Tech Wisdom

IC-2AT Mod

(Reprinted from January '89 *NCARC Communicator*.) I routinely use a half-wave antenna on my IC-2AT handheld. There is a certain amount of movement of the center pin of the BNC connector with the half-wave antenna on the handheld. This movement causes fatigue fracturing of the wire connecting the printed circuit board to the BNC connector.

After numerous failures, I used the braid of RG-174 coax to make the connection, and describe its application here. First remove the BNC from the radio and break off the non-used ground lug. Then place the pin of the BNC into the end of the braid. Then wrap a thin piece of wire around the braid 3–4 times, and secure and solder it. Reinstall the BNC and dress the braid to the solder pad on the printed circuit board and solder. Do not heat the braid too long while soldering, as solder will be drawn up, making it stiff and subject to fatigue fracturing.

KA8CNI

Frequency Pick-off for Your Dummy Load

Years ago, the word "gimmick" referred to a wire inserted close to the VFO or HF rig to cause a change in frequency due to capacitive coupling for FSK with RTTY operation. I decided to add a gimmick to my dummy load to sample RF (see Photo A).

I use a dummy load to test and align equipment, and I also wanted to use it to check the signal on a frequency counter, deviation meter, and oscilloscope. Adding the gimmick required drilling a single hole in the end plate of the dummy load and installing a BNC connector with a length of 1/16" brazing rod soldered to the center conductor (any stiff wire will do).

The RF level picked up by the gimmick varies with both frequency and power. The highest level of RF sampled is at the highest frequency at the highest power. Exercise caution. You may want to use an attenuator or other method to ensure that the RF level does not exceed the limits of your test equipment.

W.C. Cloninger, Jr. K3OF
Rockville MD 20853

ICOM IC-37A Tips

(Reprinted from December '87 *220 Notes*.) The Condor Connection is an incredible 220 MHz repeater system linked from San Francisco to Las Vegas to San Diego. The 27A, 37A, and 47A rigs are so similar that the following tips should apply to all.

1. To improve high frequency receive audio response, replace C103 on the main unit with a 0.0022 µF (2200 pF) Mylar™ capacitor.

2. To improve low frequency receive audio response, replace C106 with a 0.22 µF Mylar capacitor.

3. To eliminate distortion in the transmit audio, install a 4.7k resistor inside the microphone case in series with the white wire coming from the microphone element. Then set the DTMF level pot to the middle of its range (the only pot inside the mike case). Then adjust R88 inside the rig for the desired "mike" level.

4. To improve the receive sensitivity, power output, SWR at the radio, and reliability, remove the RG-58 pigtail and the UHF connector extending from the rear of the radio. Install a BNC chassis mount screw-in connector (UG-1094/U) in the hole left in the back of the radio. The new connector will screw in as if the modification were done at the factory.

5. To greatly reduce chassis heating in the receive mode, remove the following components: R66, R67, R68, Q32, D42, and D44 in the main unit. Install a 7808 (3-pin, 8 volt regulator) on the transmitter power amp shield behind the space reserved for the optional speech synthesizer. Thermal compound is recommended. Hook the input of the 7808 to the point where R67 and R68 are connected. Hook the output of the 7808 in series with a 1N4001 diode to J14-1. The cathode of the 1N4001 goes to the connector, and the anode goes to the 7808.

Original modification by Mark Gilmore WB6RHQ.

The Independent Repeater Association, Inc.
Byron Center MI 49315

Take Your Mike to the Dentist

If you have a new TM-701A, TM-231A, -331A, or -431A, and your FM modulation is low, you might want to pay a visit to your family dentist.

The weak FM modulation from these new Kenwood rigs lies in the supplied microphone (the MC-44DM). Its housing has a very small hole for capturing audio. I tried to adjust the FM deviation in my TM-701A, but I didn't make much progress. Then I decided to enlarge the hole on the microphone itself.

I took the MC-44DM mike to my office. With a high-speed drill (for drilling teeth) and a large round burr (#8), I enlarged the hole. To make the margin look nicer, I used a finishing carbide bur (#556 or 557). The result was a good 70% improvement in FM modulation.

The next time you go to your dentist, take your Kenwood mike along, too.

Paul D.A. Hoang, DMD NA1A
Malden MA 02148

Hands-Free Stirrer

Making your own PCBs used to be expensive and messy, but products like TEC 200™ Film have made it easier. Yet one time-consuming step remains—etching the board. We still have a 15–20 minute wait while we patiently agitate the board or stir the solution.

I thought there must be a solution to this problem, and I found one. My hands-free stirrer consists of a small electrical motor driving a propeller that stirs the solution (see Photo B).

I bought the motor, the crown gear and bushes, and the propeller at my local hobby shop. The motor and propeller were intended for a toy boat, and the crown gear and bushes came from the back axle of a slot car racer. The propeller shaft is a piece of welding rod, and the wood is from a tomato box. The size of plank you use will depend on the size of the dish you use for etching. The propeller shaft must be long enough

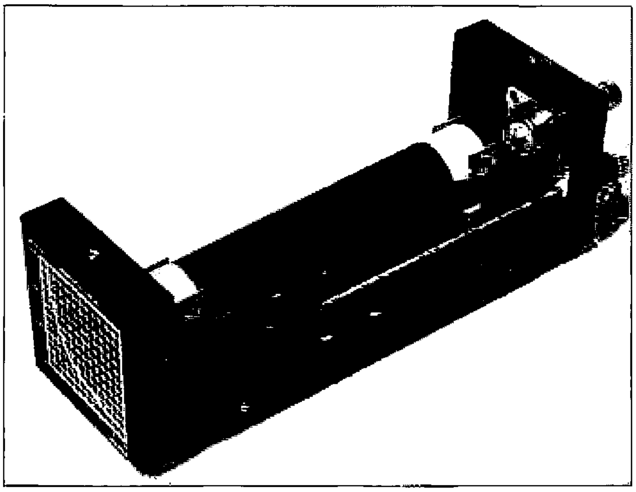


Photo A. Dummy load frequency pick-off.

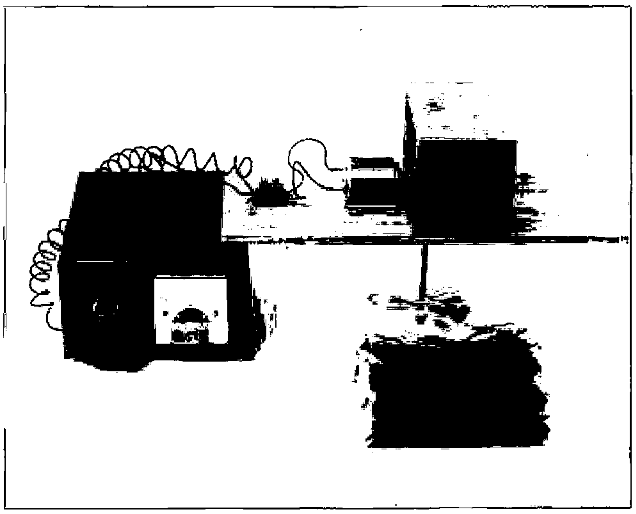


Photo B. The hands-free stirrer.

for the propeller to be under the fluid, but clear of the bottom of the dish. I have nol given dimensions because it depends on what you have in your junk box, or what you can salvage from the kid's junk box.

The motor I used was designed for 1.5 to 3 volt operation. Dropping the voltage slows the motor, which is necessary, as you don't want the liquid to splash out of the dish.

If you use welding rod, or any metal, for the propeller shaft, remember to treat it with several coats of lacquer or varnish to protect it from the etching solution. If the propeller has a brass insert, it must be treated as well.

A word of caution. If you go to the hobby shop, you'll find a magical world of toys for boys and girls of all ages. Be prepared to come home with far more than you had planned!

James Bestbier ZS1XN
South Africa

Yaesu FT-902 Mods

Adaptation from LABAK @ LA5IV via KB8CI: I have now tested about 18 modifications on the Yaesu FT-902 transceiver. I am rather surprised to see some of the circuit designs. I tested the RF-clipper (so-called Processor) with different ways of modulating it. Action was very much dependent, and reports on the air said that nobody could hear any RF-clipping. I believe that whatever level of quality, it should be possible to hear the sound of clipping. So my tests on the bench showed that the "differential clipper IC" did not really work, but with a simple modification it could be forced into efficient work. Only 2 diodes (1N4148 in anti-parallel) across the IC output did it. The output level control: I did not find any practical operation of this, either, although I found the position on the front of the transceiver. Perhaps it is mounted to use some free space? I replaced this with a 2N5462, and the 47k resistor with 10k, and yet the output could be shifted at least 6 dB (ALC operation limits the range).

January '89
NCARC Communicator

Never Say Die

Continued from page 6

Dwight Bulkley in his book, *The Mechanisms of Life,* postulated that part of the DNA replication function might include imprinting magnetic fields from adjacent benzene ring molecular segments. It wouldn't take much to upset this, particularly when we get down toward the low frequencies at which the body seems to be working.

Not much work has been done yet on VHF frequencies, so we really don't know what cellular effects they may have. It's sobering to reflect that a six-foot person makes a dandy full wave tuned receptor at two meters. Two meters is about six feet, you know. Then, if we add those deadly low frequency PL tones to the mix. . .? Maybe we've been doing our kids a favor by making it so difficult for them to get into ham radio, thus perhaps signing a warrant for their early death.

But heck, though you aren't into pot and crack, a discouragingly high percentage of you are addicts and are shortening your lives. I see you smoking, drinking those 807s and waddling by my booth at hamfests. As a reformed smoker, drinker and eater, I'm as righteous as they come. Yes, I smoked once. I even got expelled from school for it. Drank for a while, too. I finally got fed up with being fat and took off 85 pounds 16 years ago—and kept it off.

So I can understand why, as long as you're knowingly shortening your life with tobacco, alcohol and fat, the added problem of getting your cells scrambled by 60 Hz magnetic fields might not rate a high priority.

Yet, when you consider that over 50% of the women with pregnancies and working with VDTs in some newspaper and airline offices have had miscarriages or children with severe birth defects, we're not talking some vague late-life misery. We're talking a powerful genetic disrupting force which can knock you and your family out in short order.

This book should put an end to any further decisions to implement the Navy ELF systems for submarine communications. It surely will put their 420 MHz long-range radar systems, which are pulsed at 18 Hz (Cape Cod) out of business once the local people get wind of what it's doing to them.

In the meanwhile let's get going on some inexpensive gaussmeters.

What's Doing at *73*?

The lack of youngsters coming to amateur radio has sure put a crimp on my ability to find enthusiastic young hams to work at *73*. In the past I've hired hams interested in learning about publishing and being involved with the hobby. I never had any problem finding youngsters—OMs and YLs—to work with me testing new ham gear, editing the magazine, helping at hamfests, and keeping W2NSD/1 active on all bands and modes. Today, with *73* growing again, finding young staffers has been very difficult. I've been advertising in *73,* the New Hampshire and Boston papers, and even trying employment agencies.

You'd think I'd have a stream of youngsters calling. Heck, how could a ham ask for more fun? I've got a new hamshack with the latest in ham gear, a huge new tower and beams. I need help in getting back on OSCAR again, setting up with the newest in SSTV, packet, adding features to our 2m repeater system—things like that. That's not work, that's fun for a young ham!

Yes, of course, there's *73* work, too; helping find hams who have built gadgets we'll all want to read about, keeping up with the state-of-the-art in ham experimenting (let's see, where's that article on a narrowband quenched gap rig?). And since I can't get to as many hamfests as I'd like, I need someone to shave his head, wear my W2NSD/1 hat, and give booster talks at hamfests. With some dark glasses no one will ever know it isn't me.

Lacking youngsters for *73*, perhaps there are some readers who'd like to help out at home. You can't get me back on OSCAR, but you can let me know how you like any new piece of equipment you buy. I'm sure all the *73* readers would like to know about it. No, we're not interested as much in a laboratory report as we are in a ham shack report.

When I'm thinking of buying something new—which is most of the time, a lot of thinking, not so much buying—I want to know what others who've bought it have found. Is it easy to use? Is it fun? Does it do everything the ads say? What do I need to go with it? I want to know how it was for you and how you think I'll like it.

Wouldn't you rather know how other average hams make out with new gear than read a scientific lab report? On a transceiver, how useful are the memory channels? How easy is it to change bands? What kind of signal reports does it bring? Will it control my amplifier OK? What problems may I run into?

Let's say you've finally made the big move and bought a packet unit. What happened? How has it worked out for you? Are you happy with it or do you wish you'd bought another? How was your first packet QSO? Are you having fun? Would you recommend we all give it a try? Any helpful ideas to make our packet experience more fun?

I'm not going to be satisfied until I'm able to publish reports from users on every new piece of ham gear, from the largest to the smallest. I want to be able to look back in *73* and find out enough about anything I'm interested in to make a buy/no-buy decision.

The Drum Contacted

Well, it took a while, but I finally made a contact with the *USS Drum SS-228*. As it says on the card, the *Drum* was named for a large sea bass found off the North Atlantic and Gulf coasts. Built at Portsmouth, New Hampshire, she made 13 war patrols, and was awarded 12 campaign stars and sank 15 Japanese ships totaling over 80,000 tons.

The *Drum* is tied up at the Battleship Park in Mobile. If you get a chance, stop by and pay it a visit. You'll find the *Drum Newsletters*, which I've been publishing for many years, on display. They tell the fascinating stories of our adventures.

Murray Flanders K4RQQ has been operating from the *Drum* in recent weeks. You might take a listen for him on 14,243 on Saturdays at around 1830Z, but don't jam the Submarine Veterans Net.

I reported aboard the *Drum* as a Radio Technician in 1943 and served on her for her last five war patrols. We saw plenty of action all around the Pacific.

It was fun finally making a ham contact with the *Drum* 45 years after serving on her.

Actually, we sank more than we got credit for. I remember some ships we torpedoed and heard sink and break up—a very distinctive and upsetting sound. The Japanese patrol boats kept us from coming to the surface and seeing the ships sink, so we never got credit for them.

> **"Isn't it time we set some goals for all of us to seek—some tough goals?"**

Ham Merit Badges

The Boy Scout merit badge system has a lot to recommend it as a way of encouraging youngsters to achieve skills. So how come we don't have a similar program going in amateur radio? It seems like a good idea to me, even if I did think of it (in the shower, where most of my ideas arrive).

The Boy Scout merit badges aren't easy to win—neither should ham merit badges. For instance, a DXing merit badge might be achieved by hams who have over 300 countries confirmed. That's 300 out of the 400 of the DX Dynasty Award, where all countries are accepted as such by IARU member societies. It takes some dedicated DXing to work 300 countries. Oh, it's not difficult to work 100 countries in a weekend—I've done it. 200 took me a month. 300 a year.

How about an RTTY badge? 100 countries and all 50 states makes sense for this one. Ditto a slow scan badge. We're not talking easy for either achievement.

What would you recommend for a 160m merit badge? I'd say 50 states and 100 countries again. 80m might require the states and 150 or 200 countries. Make 'em really work for it.

Why not a DXpedition badge for operating from 10 countries—with at least 500 contacts per country? Or should it be a thousand? If it's easy, it won't mean anything, nor will it really benefit the hobby. Wouldn't you like to see several DXpeditions on the air every weekend?

A ham author badge might go for having ten articles published, each at least two pages long, in any of the four major ham magazines. No columns, please, I mean articles.

What's a difficult, yet attainable, goal via OSCAR? 50 states and 25 countries? I haven't worked all the states, but I've worked well over 25 countries via an OSCAR.

We definitely need an Elmer badge, perhaps for getting ten new hams licensed, and not just to Novice or Tech.

Most of my suggested badges will take about a year to achieve. Have you any ideas for other badges we might offer?

How about something for contests? Perhaps we might ask that you win as a single operator for your section an ARRL DX contest, a VHF contest and the Sweepstakes—the Big Three. Yes, I've won all of 'em, so I know it can be done. I can also guarantee you it isn't easy.

What can we set up to encourage activity on 10 GHz? How about making contact with at least six grid sectors? I've worked seven states on the band, so you should be able to work six sectors. I'm not asking anyone to do anything I haven't. I did it with 1/10 watt, too, with all contacts over 50 miles and one over 100 miles.

The idea is to come up with amateur radio badges which will help amateur radio to be more fun—to grow—to provide better service. Like perhaps one for QRP with confirmed contacts with 150 countries with less than one watt input—and none of this calling with a kilowatt and asking them to listen for your QRP signal. All contacts would have to be initiated with QRP. Should we make that more countries?

I'd suggest one for mobile, but I remember the chap in California who used to back his car up with a big beam on a tower overlooking the Pacific Ocean. He whacked off countries by the dozen. We don't want easy stuff. Any ideas?

We should have one for six meters—to help get us more activity there. With the sunspots rising rapidly and the possibility of the highest sunspot number in a hundred years or more, working DX will be pretty easy on 6m. I'd suggest working 50 states, but darned few have done that, so it might be asking too much. Would you settle for 40 states and 40 countries?

Judging from the zero number of hands going up during my talk at the ARRL convention in Boxborough when

I asked about some of the above accomplishments, most of the merit compplishments, most of the merit badges I've suggested will be difficult. And they should be. If they're easy the badges won't have much value.

Isn't it time we set some goals for all of us to seek—some tough goals? My DX Dynasty Award is tough, but it's too vertical. I'd like to encourage every ham to be well-rounded in interests, not to spend every spare moment for life chasing DX or talking with the same small group on a 75m net. Yes, I've done that too, and it's an experience I'll never forget. I made some great friends—Bill and Olga W1IF in Peabody MA, Homer W1KPL in Jaffrey NH, Leo W1MLJ in Barre VT. But then I've enormously enjoyed other things in my life and then moved on—like flying, boating, horseback riding, rallying and sports cars. Some interests have stuck—like ham radio, skiing and scuba diving.

If we don't start getting some action on 2.3 GHz and the other satellite bands, we're going to lose 'em. What goals can we set for 2.3 and 3.3 GHz?

Perhaps an Elmer merit badge will build more interest in the preservation of our wonderful hobby—a quality which is at a particularly low ebb at present. It sure seems like we have a bunch of hams who would rather see amateur radio closed down than consider some type of no-code license. We don't stand a prayer of getting the kids into amateur radio while we have our Victorian-era restrictions.

If you like the whole idea of ham merit badges we'll get started with it. We'll have to have a contest for merit badge designs, plus make up some nice certificates for the shack wall. And, yes, you bet we'll run an honor roll in *73* showing who's achieved what badges. Now, should we accept achievements from the past or should we start everyone even on January 1, 1990? Since I already qualify for many of the proposed badges, naturally I'm all for accepting past work. It's up to you. If you don't write, you're going to have to shape up to the rules set by those who do write.

Let's see—what performance by a Novice on 10m might warrant a merit badge? 200 countries? Getting a QRP badge should be easy there as the sunspots heat up.

The Webster Bomb

Up until Noah Webster came along and forced standardized spelling down our throats—spawning spelling-bee abominations and endless put-downs for engineers—English words were spelled pretty much as they sounded.

Yes, "know" used to be pronounced more like canoe—we've just gotten lazy and kanocked off the kay when we speak. Now, if we're allowed to change pronunciation to suit ourselves, why not bring our spelling in line? No, this isn't a new idea, it's just one which should be considered, now that the end of the century is within reach.

There was an article in *Analog* on simplified spelling along about 40 or 50 years ago—"Mahem In Ce Klasroom," as I recall. I also recall that John Campbell, the editor, mentioned that the article had been submitted anonymously and never claimed. John W2ZGU smoked heavily and is thus no longer with us.

The problem is—how can an individual break this log-jam Webster has brought on us? How can one person get the English-speaking world to start fixing its spelling system? I suspect the government is too busy dealing with world miseries, Russian adventurism (modern colonialism) on every continent, a fractious Congress, mountains of lobbyists pushing cigarettes, guns, price supports, unions, etc., to worry about something as inconsequential, and potentially explosive, as modernising spelling. The Pribilof Island baby seals carry more weight. . . or "white," as it's pronounced in Australia.

So if the government is too busy, and education is planning to celebrate the beginning of the 20th century soon, how can we get some movement? One way is to be sneaky about it. You no, we mite just be able to get this started via amateur radio. Mite makes rite is an easier spell for CW, RTTY and packet, so what are we waiting for? Give it some thought.

We certainly can follow the recent English change of -ize to -ise on modernise. It won't rid us of zees entirely, but it cood sure save wear and tear on the zee key. We'll still need it for pizzazz, dizzy and lizzy. But, hey, we could cut those zees in half and not lose anything. Pizaz? No, you cant substitute pissass.

It looks to me as if we could save on several dollars worth of apostrophies. Theyre a hangover we dont need too. And no, I have no objection to spelling the same sound different ways—as long as we dont hold onto silent letters. To, too and two Ill buy—tho Im not sure about two—what's that lousy w doing in there? Ill bet no ones pronounced the w for a cuple hundred years or more. Twos bad enulf, but how about eight? Lordy! How on earth did they ever pronounce that bunch of now silent letters? I can see why they've stopped.

Videos

One extremely frustrating aspect of publishing is to see firms by the hundreds just plain throwing away money and then wondering why business isn't better. I got fed up with the almost universal appalling ineptitude in taking advantage of the free advertising that publications offer, so I put together a video to explain precisely how to get at least $1 million more in sales per year just by effectively using PR.

The $99 video has been out for just a short while, yet the testimonials are already coming in—asking if I have any other videos available. Well, I've got a couple in mind.

The basic premise of the million dollar video is simple. A new product release published in a magazine is normally as effective in generating sales as a full page ad. A product test report can be as effective as four pages of ads. Since a magazine with 100,000 paid readers will have ad rates of about $5,000 a page, and the rule of thumb is that mail order advertising should pull a minimum of ten times the cost of the ad, a new product release should result in about $50,000 in sales and a new product test report should pull about $200,000 in sales. At that rate it doesn't take a very concerted effort to build that extra million in sales I promised.

As a publisher of 25 magazines over the last 35 years, I can tell you that I have yet to run into a PR person or even PR firm that really knows how to get releases and test reports published. So I revealed this heretofore secret scoop in my video.

The next video will be on how to double your business by more effectively using reader's service responses. Surveys down through the years have always shown that the firms taking full advantage of a magazine's reader's service cards can at least double their mail order sales.

Here's where I need your help. The fact is that pathetically few advertisers make good use of this powerful marketing medium. Most just plain throw away good money with poor reader's reply materials—frustrating magazine readers who are anxious to buy.

Rather than sending a bunch of reader's service labels addressed to me, which might be a give-away, how about you doing it and letting me know what happens? Check off up to ten reader's service information responses which interest you. Make a note of the date you send us the card and the firms from which you've requested information. As you get the material from them, record the date and then look it over carefully so you can let me know how effective you think it is.

You might rate each package on a one-to-ten basis on how much it made you want to buy the product. If you actually do order something, that's obviously a big plus. Then keep a close record of when you placed your order, whether by mail or telephone, how soon it arrives and how satisfactory the product is.

I'll take the information you send and use it in my video as examples of the best, the worst and the average in reader's service sales literature and response.

There are some benefits. First, the better the *73* advertisers get at sending sales literature, the more they'll sell. The more they sell via *73*, the more they'll advertise. The more they advertise, the more pages I'll have for articles and the thicker magazine you'll have to read. Also, the more advertisers there are in *73*, the more will be attracted, making the magazine even fatter for you.

What should you look for from the advertiser? Well, you certainly want to know about the product in some detail. And you want to know what the benefits are to you of buying the product. What can you do with it? How easy is it to use? You want to know the price. You'd be amazed at how many companies neglect to mention the price, apparently under the odd impression that you really don't care how much it costs.

Do they make it easy for you to buy or do you have to try and find a dealer who has it in stock before you can order?

Does the literature answer all of your questions? Does it communicate the excitement of the product so you want it right now?

Let's get busy and see what we can do to educate advertisers on how to sell their products to us. Buying new ham gear and putting it on the air is fun, so let's get their sales literature doing the work it should.

Yes, I'll keep track of your votes on the literature and publish a list of the firms which get the highest scores.

Data 101

At first I thought it odd how few audio industry people I met had a real grasp of digital sound. With the background of a lifetime of dealing with phonograph records, it's easy to get the feeling that a compact disc is just another way of recording sound—like a record, only read with a laser instead of a needle.

The information on a compact disc isn't anything like that on a record. With digital sound what we do is sample the level of the sound 44,100 times a second and convert the loudness into binary digits. This binary (digital) code is then stored on the disc as little bumps which are then read with a laser and fed into a computer.

The computer in this case converts the digital data back into levels of sound with a digital-to-audio (D/A) converter circuit. We bother to do this because this system overcomes many of the drawbacks we have to cope with when embossing grooves in vinyl records. LPs and their players have all sorts of limitations which get increasingly expensive to surmount as perfection is attempted.

For instance, if the hole in the center of the LP is off even slightly we can hear a slight wavering when we listen to piano music. LPs aren't made to laboratory standards, so there's always some wow due to the center hole being slightly off.

Then, unless we go to heroic measures, there's some player motor rumble. All this is nothing compared to the needle and pick-up problems. The needle either has to be very hard so it won't wear, or else you have to change it all the time. When you pass the needle through the grooves *something* is going to wear—so if it isn't the needle, then it's going to be the record grooves. Fanatics play their LPs just once and record the sound on tape. Other than a laboratory clean room, there's no way to keep dust from being attracted by the record. It's vinyl, so the slightest brushing of it (or playing) knocks off electrons, making it a magnet for room dust. Dust in the grooves can be heard.

Then there are the compensation problems. Loud bass notes have to be

reduced so the grooves won't overlap. High notes intermingle with the sound of the needle on the vinyl, so they have to be increased to stand out. The whole process is a mess, calling for expensive solutions to each of the drawbacks of the medium.

Tape is as bad—just different. Even the best tape systems have a basic tape random noise hiss level which sets the lower level for sound we can record. Alas, there's no way to separate this hiss from the weaker sounds we're recording. Thus, instead of silence between instrument or orchestral music notes, we hear the tape hiss. There are intricate circuits to cut down this hiss, but it's a basic limitation of any analog tape system. This is something audio fanatics who tape their LPs in order to preserve them just have to live with.

Another serious tape problem is bleed-through. This is the imprinting of louder sound passages from one layer of the tape to the next. You hear it as musical ghosts preceding or following loud sounds.

One other point—duplicating. Whenever we make a tape of an LP we lose just a bit, plus add more tape hiss with each generation. After a few generations of copies the sound is often degraded beyond acceptance. With digital sound each generation is perfect—there is no loss or addition of anything, no matter how many copies of copies are made.

Now, with digital, we get away from all those problems. No wow due to off-center holes or player speed variations, no rumble, no tape hiss or needle noise, no problem with needle inertia, jumping grooves, dust and so on. You can see why compact discs got so popular so fast. With digital sound there is zero sound added by the system—so you're able to record and play back total silence, if you want.

In practice it's impossible to get concert halls or even recording studios absolutely silent. People make noise—breathing, shuffling feet, turning the pages of their music, squeaking their chairs slightly, coughing, whispering and so on. Even with sound-proofed walls there's still some sound from passing trucks, airplanes, an air-conditioning system, electronic equipment with blowers and motors—and you can hear all this stuff during the silent passages between notes. Well, it isn't any more than you'd hear at a concert, so what's the beef, right?

Now, with that background, and remembering that all we're storing on compact discs is digital information, perhaps you can understand why it's just as easy to translate the digital information into anything else we want. This is where they came up with the CD-ROM—where a compact disc is used to store data which a computer can then use.

The computer age has changed the definition of the word "information." Our computer systems can convert information (digitally stored data) into music, into names and addresses, into computer programs, into graphics, even into video. It's all data and this concept has profound implications for amateur radio.

We've already had amateurs sending digitally encoded music over the air, and it's legal. We send data—what it's converted into by a computer afterward is irrelevant. It can be words which make messages, music, pictures, a newsletter page, or even porno movies. All quite legal.

If we're going to send data at a 44.1 kHz rate, we're going to need channels about 200 kHz wide. The bandwidth is determined by the amount of data you want to transport per second. For just plain words the amount of data can be very small. Real-time video is a hog.

No, until recordable compact discs come along, we can't use 'em for much in amateur radio, but we will be able to use digital audio tape (DAT) or even pulse-code multiplexers (PCM) with video tape recorders to store digital data.

I've mentioned that by encoding our English words into 16-bit bytes we can handle a 64,000 word dictionary, with each word being defined as a number between zero and 64,000. At a 117K baud rate we can thus send about 350,000 words per minute through the system. This data rate is possible through our ordinary telephone lines, so we should be able to gear up to accommodate it via amateur radio links.

With the average amateur message running maybe 240 words, we're talking about a 25th of a second to pass the message. If we move it up to one of the music sampling standards of 32 kHz, 44.1 kHz or 48 kHz, this would move the data through much faster—three, four or five times as fast—getting us down to a hundredth of a second for the average ham message. At this rate, if we have a communications network which stores and forwards the data, we don't care as much about bandwidth. We trade off bandwidth for throughput.

If you think all this is blue sky, you haven't been reading the papers. AT&T is gearing up to provide an interconnection between computer/communications systems in the 1990s. These systems will automatically accept any individual communicator and integrate the user into the whole worldwide system. It won't matter if the communication system you're using is in your home, at your office, in your car, on your boat, or even in your hand as you walk. It'll instantly integrate into AT&T's world data communications system when you turn it on.

Now, are we going to be left completely behind in the dust, braying our CQs and fighting pileups on 20m? AT&T is purposely setting up their coming system to encourage third-party firms to develop equipment, software and accessories to compliment the whole system—using the approach IBM did to get their PC accepted quickly. This means that there will be zillions of opportunities for small firms to be set up to provide specialized equipment and services, all supported by the worldwide AT&T wide area network (WAN).

Thus hams who take advantage of the wide-open opportunity to experiment with digital communications systems on our ham bands will have an enormous advantage over late comers to the field.

If you're interested in reading more about this developing technology, let me know—or would you rather I start digging up articles on quenched-gap spark and MOPA rigs, exercises in nostalgia from the Good Old Days of amateur radio? Please advise.

Boy Scouts No-Code News

A recent news release from the Boy Scouts of America says they're now offering a merit badge for shortwave listening. It went on to say that up until now the Scout Radio Merit Badge had been based on ham operating skills.

Unfortunately, the Radio Merit Badge has drawn so little interest in recent years that it's now going to be based on logging shortwave broadcasts instead of getting a ham license.

The end of another era in amateur radio.

Selling Frequencies

Were you one of those who laughed when I wrote about the FCC auctioning off frequencies? It's time to laugh again because the Bush budget estimates $563 million per megahertz, with a start of 6 MHz being made available. That isn't going to balance the budget, but heck, an extra $3.4 billion a year here and there won't hurt.

If the FCC decides to take our 1200 MHz band, they might be able to rent it for $338, and that would make a major difference in the budget deficit. Perhaps we should offer our virtually unused UHF bands up for grabs and give Congress a whole new lease on spending.

A letter from a ham reader in California said, "Some months ago, a member of our federal legislature was in my apartment and the subject of 220 came up. 'What is this 220 MHz that I've been getting all those letters about?' I turned on my receiver and said here it is. After twenty minutes, the comment was, 'How can anyone justify frequency allocations for that trash?' What could I say?"

The Radio Frequency Market

More and more governments are talking in terms of renting radio frequencies instead of having them issued free by government bureaus. Technology advances have enormously increased the number of communications services and needs. This has put an impossible load on the bureaucrats issuing frequencies.

If the FCC goes ahead with its plans for renting radio channels, how wide a band will we amateurs be able to afford? Let's say 20m is put up for rent. At about $1 million per year per 5 kHz channel, how many kHz can we afford?

Let's say we decided to go for a modest 25 kHz ham band. That would be $5 million a year in rent. If we split that 30,000 ways, that's $170 each for us per year. If we figure 365 days and 16 hours per day times five channels, that's 29,200 channel-hours available per year—about one hour for each of us. $170 per hour. Hmmm. I dunno, but I think I might be able to get more enjoyment for $170 for one hour somewhere else.

Of course, we can always get busy and get more young hams into our hobby and maybe put a stop to this nonsense.

Mr. NiCad

It seems as if Mr. NiCad (Ed Yost) has a booth at just about every major hamfest. Ed's specialty has been keeping our HTs perking. And, considering the frailty of these batteries, he's made a nice business out of it.

Sure, if we took care of our NiCads they'd probably last almost forever. But, alas, we use them in so many pieces of equipment, one almost needs a full-time support person to keep 'em in healthy condition.

I've got 'em in my flash units (4), portable radios (4), several toys (5), cassette recorders (3), calculators (6), portable CD players (3), laptop computers (9), boombox, razor, HTs (10), portable disk unit (3), electric drill, flashlights and so on. There's no way to remember to keep 'em all charged. Or to remember to discharge and then recharge 'em periodically. When I go on trips I have to throw in about five pounds of different chargers because they use a wide variety of voltages and currents.

I've asked a couple of times in my editorials for someone to build a simple, but complete NiCad charger unit which would automatically discharge 'em to erase their pesky memory, have a zapping current to burn out small shorts which tend to develop, recharge them the proper amount and then keep them trickle-charged for use.

The best unit I've seen so far is commercially available and not cheap, but well worth the price just in the batteries it would salvage for me. I've a review article on the unit which we'll be publishing soon.

At any rate, I wasn't surprised when I checked out my HT's spare batteries and found one which wouldn't charge. I opened it up—two cells were dead. Not having that commercial charger to zap the dead cells back to life yet, my thought turned immediately to Mr. NiCad. A call and he had a replacement pack on its way so I wouldn't be in trouble for my upcoming ham conference in Aspen. I UPS'd the wounded pack and had it back in good shape less than a week later—a spare for the trip.

You could do worse than keep a Mr. NiCad price list on hand for when an HT battery zonks out. It's a good place to shop for HT chargers too. Ed seems to have an amazingly complete inventory on hand. 73

NEW PRODUCTS

Compiled by Linda Reneau

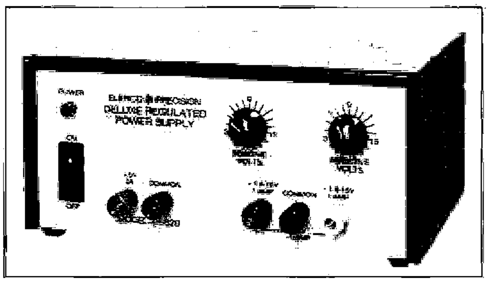
PRODUCT OF THE MONTH

GAP ANTENNA PRODUCTS, INC. THE CHALLENGER DX-V

G.A.P. introduces its Challenger DX-V, a 5-band, 31.5′ high vertical antenna. The Challenger, made of aluminum and stainless steel, weighs 50 pounds, and is self-supporting. You can assemble it in thirty minutes; all sections fully sleeve and have been pre-drilled. A nut driver and drop-in ground mount are supplied.

The Challenger DX-V launches the RF 16′ above the ground, and gives less than 2:1 SWR on 10m, 15m, 20m, and 40m. The Challenger has no traps, coils, baluns, resistors, transformers, or base insulators to steal RF power. This pre-tuned antenna performed well without radials on 10m, 15m, and 20m.

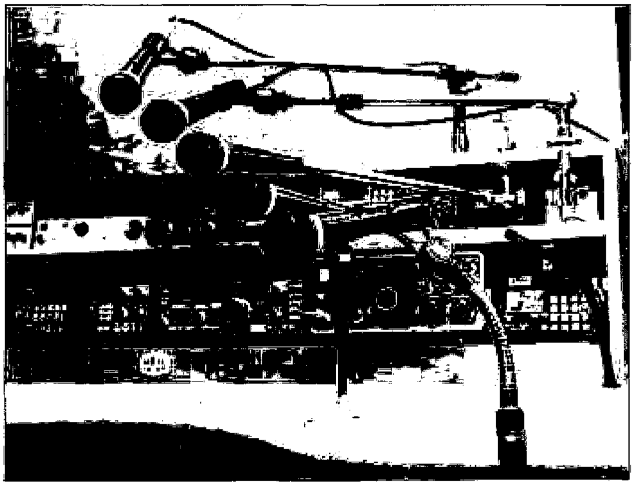
The Challenger DX-V sells for $169 from the manufacturer. *G.A.P. Antenna Products, Inc., 6010 Bldg. J, North Old Dixie Hwy., Vero Beach FL 32967. (407) 388-2905.* Or circle Reader Service No. 201.



ELENCO ELECTRONICS, INC.

The Elenco XP-620 is a fully regulated 3 output power supply. It provides one fixed voltage 5V DC at 3 amp, and two variable supplies: 1.5V DC to 15V DC and −1.5V DC to −15V DC at 1 amp. The voltage shuts off if a short occurs. The supplies are regulated to better than 0.2V when rising from no load to full load.

The unit measures 8¼″x7″x4″. $90 assembled, $60 in kit form. *Elenco Electronics, 150 W. Carpenter Avenue, Wheeling IL 60090.* Or circle Reader Service No. 202.



HEIL SOUND

Heil Sound has taken some of the professional hardware used on the stage, at recording studios, and in broadcasting and retooled it for your amateur radio station. By carefully selecting components, you can design your audio system to meet your requirements and give you hands-free operation.

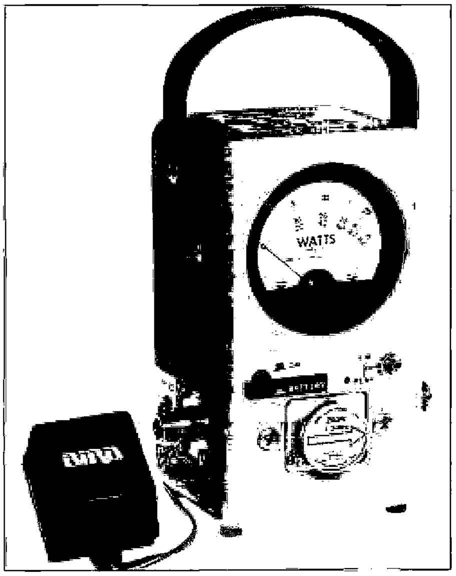
Call Heil Sound and request information about Concept 2000. *Heil, Ltd., Heil Industrial Blvd., Marissa IL 62257. (618) 295-3000.* Or circle Reader Service No. 203.

BIRD ELECTRONIC CORPORATION

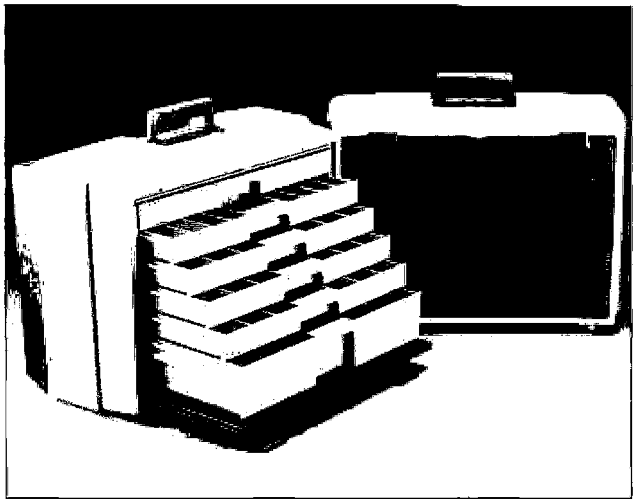
Bird Electronic Corporation now has a portable peak-reading wattmeter, the model 4314B, designed specifically for measuring air navigational aids and other pulsed RF systems, such as telemetry, radar, TV, and command/control. It also measures PEP of SSB and AM signals. Performance specifications are identical to Bird's model 4314, which it replaces.

This new model measures practically any 50Ω coaxial transmission: pulsed, AM, FM, or CW. A CW/PEAK switch allows quick selection. In PEAK mode, you take a peak measurement; in CW mode, the meter works like a standard Bird Model 43 wattmeter.

The meter is powered by two internal 9V alkalines with twice the battery life of the previous Bird model. Or you can use the supplied AC power adapter. Model 4314B is equipped with two Bird QC "Quick Change" female N-type connectors, and is available with other Bird-type QC connectors.

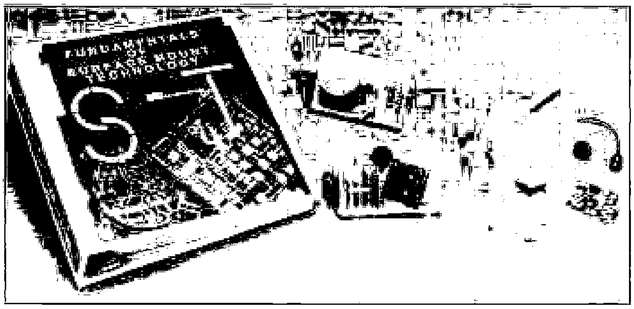


Power and frequency range are 100 mW to 10 kW and 0.45 MHz to 2300 MHz, using Bird plug-in elements. The unit is rated at a maximum insertion VSWR of 1.05 to 1000 MHz, 1.1 to 2300 MHz. Accuracy is ±5% of full scale CW, ±8% of full scale peak. The meter weighs three pounds. Price, $750. *Bird Electronic Corporation, 30303 Aurora Road, Cleveland OH 44139. (216) 248-1200.* Or circle Reader Service No. 206.



CONTACT EAST

Portable, small parts storage cabinets, made from tough, high-impact plastic, are available from Contact East. They feature rust-proof hardware, removable drawers, and doors that latch to prevent accidental openings. A padlock tab will accept #10, #7, or #3 locks. Three models, with different combinations of drawer styles, are available. Price, $78. *Contact East, 335 Willow Street South, PO Box 786, No. Andover MA 01845. (508) 682-2000.* Or circle Reader Service No. 204.



HEATH COMPANY

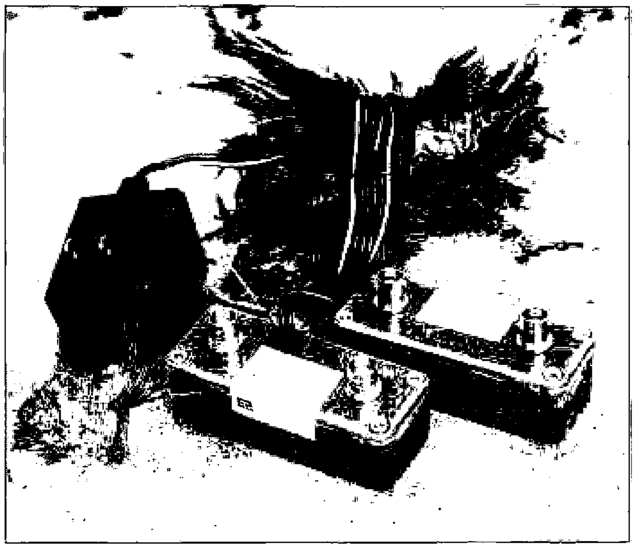
Heathkit/Zenith Educational Systems now offers a new home study course, "Fundamentals of Surface Mount Technology," developed by Forrest M. Mims, III.

The course teaches the basics of planning, designing, assembling, and soldering surface mount boards, and directs students through the hands-on assembly of a practice board, an audio oscillator, and an LED bar graph and other projects.

The home study course requires a 15W soldering iron. You can complete the course in a week of evening sessions and earn three Continuing Education Units (CEUs). Price is $100 and order number is EI-3135.

You can order the free Fall 1989 Heathkit Catalog by calling *(800) 44-HEATH* or by writing *Heath Company, Department 350-046, Benton Harbor MI 49022* or by entering *GO HTH* on CompuServe. Or circle Reader Service No. 207.

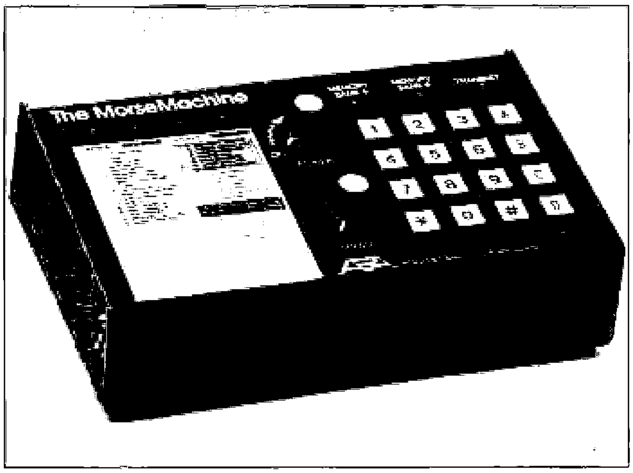
Interested in ham radio's hottest new mode? Check out next month's special Packet issue!



ELECTRON PROCESSING, INC.

The RFP-50 signal intensifier receiver preamplifier, new from Electron Processing, is mounted at the antenna to take full advantage of incoming signals. It is housed in two 1.25"x1.25"x3.5" cast aluminum enclosures with lightning and static protection. You can place the separate power unit, either a 110V AC or a 12V DC ($4 extra) supply, inside, near the receiver. The RFP-50 provides 15 dB of gain from 1 MHz–1300MHz, with a low 2.8 dB noise figure.

The RFP-50 is $100, with quantity discounts. The price includes your choice of BNC, SO-239, or F connectors. N-type connectors are also available for the RFP-50 for an additional $25. *Electron Processing, Inc., PO Box 708, Medford NY 11763. Sales Department, (516) 764-9798.* Or circle Reader Service No. 205.



ADVANCED ELECTRONICS APPLICATIONS, INC.

New from AEA is The Morse Machine MM-3 keyer, with digital and analog selection, to help you increase your code speed and QSOs. Store 8,000 characters of memory in 20 memories (36,500 with 32K RAM).

The training system provides random code group practice, a four-letter word generator, and a Dr. QSO™ simulator. It also has automatic serial number insertion and incrementing in any memory message for contesting and six programmable modes of operation. RS-232 compatible for computer operation and on-screen display of practice sessions.

Amateur net price, $190. *Advanced Electronic Applications, Inc., PO Box C-2160, Lynnwood WA 98036. (206) 775-7373.* Or circle Reader Service No. 208.

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

Optoisolator Circuit for TTY

For the last two columns, I have responded to many requests by describing several one-chip circuits to enable you to become active on RTTY with a minimum of time and expense. While many of you have computers or video terminals, I am quite sure that many of you would still like to interface these one-chip wonders with a more conventional RTTY loop. To wit, this month's circuit.

Here we use one of my all-time favorite devices, an optoisolator, to convert either a TTL level or RS-232 level to the more common current loop for TTY.

Resistors, Transformers, or Relays?

Before we get too deeply into the circuit, though, a word or two about the optoisolator. You might think you could convert the high level loop current to the low level RS-232 or TTL current with resistors, or a transformer, or some similar device. While you might be able to have some information transfer that way, there is an inherent danger. If the transfer circuit were to fail, high level current might be allowed into the TTL device. At a minimum, this would fry some components. Maximally, it could be quite dangerous.

For this reason, various schemes evolved to isolate the loop from a driving circuit. While a relay might seem obvious, conventional relays are too slow to keep up with the keying pulses of RTTY. One type of relay you can use is the reed relay. This little beauty consists of two thin reeds of magnetically active metal sealed in a glass tube. Either a permanent magnet or electromagnet will cause the reeds to react, making or breaking the circuit. Thus, driving the magnet from the loop allows the reeds to key a low voltage device. This may be ideal for a keying circuit, but the reeds cannot handle the current to key the loop itself.

Basic Anatomy of the Optoisolator

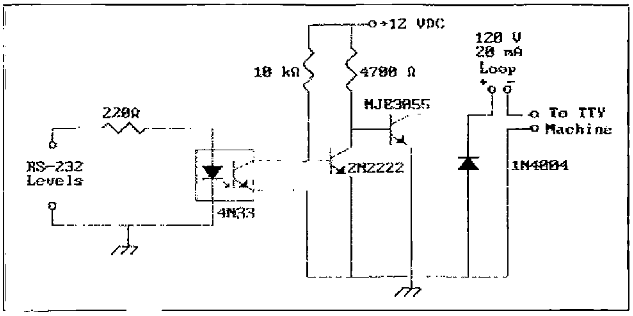
We must use another form of subterfuge, the optoisolator. Most of us are familiar with photocells, those little wonders that change resistance based on the amount of light falling upon their faces. When I was in school, we marveled at how a transistor, with the top cut off the case, makes an excellent photocell. Of course, you can buy transistors prepared this way—phototransistors, naturally.

You are also no doubt aware of the illuminating wonders known as light emitting diodes, or LEDs. Able to produce light from relatively low energy sources, these darlings find their way into almost every electronic device imaginable.

Now, if you take an LED and pot it so that it directly shines onto a phototransistor, you have an optoisolator. The output is directly controlled by the input, but there is no electrical connection; the transfer is accomplished over a beam of light.

Admittedly still a low level, now you can use the output of the optoisolator to key a transistor, and that transistor to key another, power transistor, and that transistor to key a loop. Simple, huh? Well, the figure shows the results.

While I detailed the input as RS-232, a term that should be readily understandable after my last column, TTL levels will also work nicely. You may have to experiment with the value of the 220Ω resistor. The aim is to light up the LED in the optoisolator.



RS-232/TTL to TTY converter.

The rest of the circuit is fairly conventional, and may be built on a perf board with point-to-point wiring, or on a printed circuit board. I have not included printed circuit layouts as yet, by the way, because so few of you have expressed an interest in them. If you would like for me to try to lay out a board, be sure to let me know, for future circuits.

Once again, notice the slightly anomalous power supply, with a 12 volt supply required for the transistors, and a more typical loop supply for the TTY machine. Be careful around those loop supplies, folks. They can deliver quite a kick if you lay your hand across the terminals.

Parts Procurement

Here, as before, a trip to your local Radio Shack should take care of you. Besides the local outlet, try Jameco Electronics, in Belmont, California, who supports the "Jim-Paks" found on the racks at many electronic and computer centers. You can phone them twenty-four hours a day at 1 (415) 592–8097 to check on the availability of a part or price. Another wide-based dealer I have bought from in the past is JDR Microdevices, of Los Gatos, California, PH: (800) 538–5000.

For your convenience, I listed information on all these suppliers in the parts list for this project. "RS" is Radio Shack, "JE" is Jameco Electronics, and "JDR" is JDR Microdevices. Where no supplier is listed, any of these companies should be able to order the device, but no current price is available as I write this column.

By the way, several of you have expressed difficulties with finding the Exar chips used in the last two months' RTTY Loop projects. Both of the chips are available from JDR Microdevices. The XR-2206 function generator, used for AFSK generation, lists for $3.95, and the XR-2211 decoder, used for the terminal unit, lists for $2.95. They do have a $10 minimum order, so maybe a call to the toll free number will get you a catalog for further goodie shopping. Be sure to mention *73 Magazine* and RTTY Loop when you order, OK?

Every One Different

Next month I will try to tackle the RTTY Loop Survey, the results with which you have inundated me. If there is one underlying thread already apparent, it is that there is no consistency among you. The readers of this column, and one would presume RTTYers in general, are all over the place in interests, equipment, expertise, and orientation. Looks like a fascinating study.

Meanwhile, feel free to drop me a note, with whatever comments you think important enough to convey. Electronically, I keep paying my on-line bills, so you should still find me on CompuServe (ppn 75036,2501) or Delphi (username MARCWA3AJR), via EasyPlex or MAIL, respectively. 73

RS-232 to TTY Converter Parts List

Item	Type	Source	Price
Optoisolator	4N33	RS, JE, JDR	
Resistors	220Ω	RS 271-015	2/$0.19
¼ or ½ watt	4700Ω	RS 271-030	2/$0.19
(Radio Shack parts are nearest whole values.)	10,000Ω	RS 271-034	2/$0.19
Diode	1N4004	RS 276-1103	2/$0.69
		JE	$0.12
Transistors	2N2222	RS 276-2009	$0.59
	2N2222A	JE	$0.29
	MJE3055	RS 276-2020	$1.59
Perf board	0.1" grid	RS 276-1394	$1.99

(Resistor values are nominally within 10%. For all practical purposes, the available Radio Shack values are close enough to the values specified for this project.)

Continued from page 52

Manufacturer's Specifications for the BC100XLT

Band Coverage:	11 Bands
Frequency Range:	29–29.7 MHz, 10m Ham 29.7–50 MHz, VHF Low 50–54 MHz, 6m Ham 118–136 MHz, Aircraft 136–144 MHz, Military Land Mobile 144–148 MHz, 2m Ham 148–174 MHz, VHF High 406–420 MHz, Federal Govt. 420–450 MHz, 70cm Ham 450–470 MHz, UHF 470–512 MHz, UHF T band
Sensitivity:	0.4 µV, at 29–54, 136–174 MHz 0.8 µV, at 118–136 MHz, 12 dB SINAD 0.5 µV, at 406–512 MHz
Selectivity:	−55 dB at ±25 kHz
Audio Output	480 mW Maximum
Channels	100, in ten 10-channel banks
Scan Speed	15 channels/second for scanning mode 25 Frequencies/second for search mode

end overload in normal use, even in such RF rich areas such as Springfield, MA, and on top of Mt. Greylock, a peak in Western Massachusetts, home for over half a dozen repeaters from 6m to 440 MHz and commercial TV.

The supplied rubber duckie antenna gets by for VHF and UHF bands, but really falls short in the 29–54 MHz range. If you plan to do any serious listening in the VHF-LO range, I highly recommend using a different antenna. In fact, overall receiver performance improves noticeably on all bands by substituting a simple telescopic rod. The BC100XLT incorporates a BNC-type antenna connector, making amateur antenna swaps a snap. The same, however, cannot be said of the earphone connector. Uniden uses a 3/32" sub-mini jack instead of the more common ⅛" mini jacks found on most amateur rigs.

IF image rejection is excellent in the VHF-LO range, good in the VHF-HI range, and adequate in the UHF band segment. The squelch control has enough hysteresis to prevent choppy reception under weak signal conditions. Audio output is more than adequate, with crisp, communication quality response. Intelligibility was excellent.

The NiCd battery pack provides approximately five hours of continuous use under normal listening conditions.

While testing battery life, I came across a strange quirk in the BC100XLT, possibly related to the microprocessor. After using the radio until the *low battery* alarm came on, I plugged the wall charger in for an overnight charge. The next day, I unplugged the charger, turned on the radio, and—nothing! When I turned the volume up, it would only motorboat. However, switching on the radio first, and then unplugging the charger/adapter, resulted in normal operation. It's likely that something in the AUTO-OFF feature gets confused when the pack is completely discharged. I repeated this test several times, and obtained identical results.

Bench Test Results

The bench test set-up consisted of an H-P 608D signal generator, H-P 403B voltmeter, and a Tektronix 5110 scope.

Receiver sensitivity for 20 dB quieting measured between 0.35 µV (VHF-LO) and 0.7 µV (UHF), with full quieting occuring between 30 µV and 50 µV, respectively. IF image rejection measured 70 dB in the VHF-LO band, and 45 dB in the VHF-HI band. Because of equipment limitations, I couldn't make this measurement in the UHF band segment, although everyday use suggests this figure is probably lower than the VHF-HI value.

The squelch sensitivity was 0.14 µV at threshold, and 0.3 µV at maximum setting. Squelch hysteresis measured 5 dB, and maximum audio output was 400 mW at the onset of distortion. My tests confirmed the manufacturer's specifications for selectivity, scanning rate, and search speed.

Conclusions

So how does the Uniden BC100XLT measure up? Overall performance was excellent, and uncommon for such a low price. My only complaint with the receiver is its relatively low IF image rejection figure for the UHF band segment.

As far as physical packaging goes, the only detractors were the cramped keyboard and the plastic case. If I could make any changes to this unit, I would opt for an aluminum case with a belt clip on the radio itself, since the belt loop on the carrying case is awkward to use. These are, however, minor problems.

All things considered, I conclude that the Uniden-Bearcat BC100XLT offers very good performance, easy programming, and many worthwhile features wrapped up in an attractive, low-cost package. 73

Thomas Rowinski KA1MDA has been a ham for 5 years, and is an avid auto RDFer. Tom currently works as electronics technician for Titeflex in Springfield, MA. Other interests include photography, sound design in theater, and SWLing. He can be reached at 292½ South St., Northampton, MA 01060.

Number 26 on your Feedback card

QRP

Low Power Operation

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Building a Field-Strength Meter

Getting the most out of your signal: That is the name of the game. Fine tuning the antenna system can become much easier with this handy little tool, a tunable field-strength meter. I've been using this little critter for years. Many a time I've been saved by this meter, especially during Field Day operation.

Parts

This is really a junk box project. In fact, I built the unit pictured from the odds and ends off my bench. As a matter of fact, I could probably build a five-inch color TV from what is on the top of my workbench. If you're not this well-supplied, you can get all the parts for the project at your local Radio Shack store, except for the meter. Raid a good friend's junk box for a usable meter—Radio Shack no longer stocks the model needed here.

Before we get started digging up the parts, let the soldering iron heat up a bit while we look over the schematic. You'll notice the lack of a transistor amplifier or op amp. Using a battery-powered field-strength meter would almost guarantee a dead battery just when you need it the most. The secret of a super-sensitive field-strength meter is the tuned circuit used for receiving the RF energy. No need to worry about a pooped battery when storing the meter in your tool box, or leaving it out in the sun for a weekend!

Simple Circuit Workings

Rectify the RF with a small signal diode, then apply the DC to the meter. L1 and L2, with C1, form a tuned circuit. Select either coil and use the variable capacitor to tune the LC network to resonance. A small telescopic antenna picks up the RF.

That's about it—nothing really difficult about this project! The only critical part is D1. This should be a 1N60 or 1N34A germanium diode. Don't use a silicon diode because the higher breakover voltage will reduce the meter's sensitivity.

The meter can be just about anything

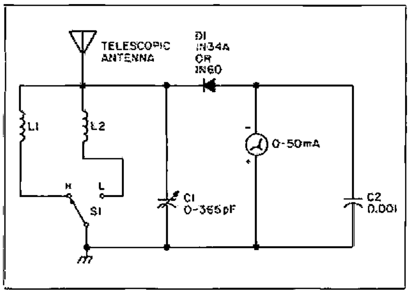


Figure 1. Schematic of tunable field-strength meter.

you've got in your shack's junk box. I used a 50 µA movement because that's what I had. You can use a 100 µA, but at reduced sensitivity. Depending on what power level you want to sniff out, you could go as high as 500 µA. Don't go over 500 µA—the meter will be insensitive.

Construction

Begin with a metal cabinet. Try not to use plastic. You want the RF to enter only from the telescopic antenna. Drill the correct size holes for the tuning capacitor and for S1. After you cut the proper size hole for the meter, mount the meter to the cabinet. In my unit, I did all the wiring using the component leads. You can use tie strips, but keep the leads as short as possible.

Quick Coils

Winding both L1 and L2 is also an easy job. I used a quarter-inch drill shank as my coil form for L2. L2 consists of 18 turns of No. 16 gauge hookup wire. Leave enough lead length for soldering. L1, the low frequency coil, consists of 36 turns of No. 28 gauge wire, close-wound. I used an old Bic Stick™ pen as my form. I cut a one-inch length of the barrel and wound the wire around it. To hold the wire in place, use a drop or two of Super Glue™. This holds the wire in place quite well.

You can, of course, use a large wattage resistor with at least 10k ohms in resistance for L1. Just be sure that you use a carbon resistor and not a wire-wound job. With both cases, L1 and L2, don't worry too much if you can't get the exact amount of turns. This is not exactly a laboratory instrument! We're not going to use it to launch missiles. A little hit or miss will not cause any trouble.

Radio Shack sells a 365 pF miniature variable capacitor. That is what I used in my unit. There's only one problem with this capacitor and those like it: They're a real nuisance to mount a knob on! Here is how I did it: I glued

Continued on page 87

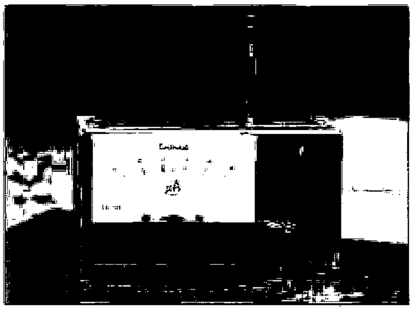


Photo A. The tunable field strength meter. A real junk box project!

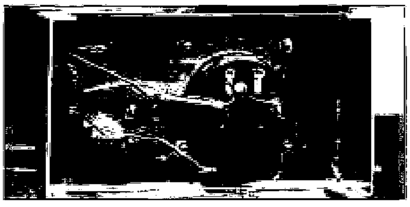


Photo B. Inside the meter. Note the lack of parts.

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the June issue, we should receive it by March 31. Provide a clear, concise summary of the essential details about your Special Event.

UNIONTOWN PA
SEPT 9

Uniontown ARC (W3PIE) will hold its Annual Gabfest at the Club grounds on the Old Pittsburgh Road. Talk-in: 147.045/.645 & 145.17/144.57. Registration $3 each or 2 for $5. *U.A.R.C. Gabfest, % John T. Cermak WB3DOD, P.O. Box 433, Republic PA 15475. (412) 246-2870.*

COTE ST. LUC, QUEBEC
SEPT 9

The Cote St. Luc ARA Hamfest/Flea Market will be held at St. Richards Church. Flea market table, $10. Fee, $2 at door. Talk-in on VE2RED, 147.27/147.87. *Joe Ship VE2JS, 5637 Melling Ave., Cote St. Luc, Que. H4W 2C1. (514) 482–6500.*

BETHLEHEM CT
SEPT 9–10

The Hen House Gang ARC will hold their 65th Annual Argil Fair at the Bethlehem Fair Grounds. Talk-in: 40m, 20m SSB, 40m Novice CW, 10m Novice SSB. Send regular SASE to *HHG, W1FHP, Hard Hill Road, Bethlehem CT 06751.*

MELBOURNE FL
SEPT 9–10

The Platinum Coast ARS presents their 24th Annual Melbourne Hamfest at the Melbourne Auditorium. Registration is $4 in advance (SASE), $5 at the door. Swap tables are $10 one day, $15 both days (limit two adjacent per request). Send request to *Hamfest, 708 Dartmouth Ave., Melbourne FL 32901.*

MOBILE AL
SEPT 9–10

The Mobile ARC, Inc., is holding their Hamfest at the Texas Street Recreation Center. Tables: $6 one day, $10 both days. Please confirm by August 25th. Tables assigned according to date of request. *Larry Early, PO Box 8404, Mobile AL 36689. (205) 342–7601 after 6 PM.*

FINDLAY OH
SEPT 10

The 48th Annual Hamfest is sponsored by the Findlay Radio Club at the Hancock County Fairgrounds. Limited camping, $5 space. Limited power and water. Advance tickets, $3; $4 at the door. Handicap parking. Flea market spaces 10' x 25'. Advance tables are $11 for first, $8 each additional, and $12 at door. Reservation deadline Sept. 1st. Prizes. Talk-in frequencies: 2m and 70cm; 147.75/.15 MHz and 449.15/4.15 MHz. *Forums Chairman, PO Box 587, Findlay OH 45839-0587.* Reservations, *Findlay Hamfest, Box 587, Findlay OH 45839.*

SOUTH DARTMOUTH MA
SEPT 10

The Southeastern Massachusetts ARA is hosting their SEMARA Hamfest. Free admission. Dealer space, $5 in advance or $8 that day. Talk-in on 147.000 + /.6 or 145.490 - /.6 as backup. (No radio test this year.) Send SASE to *SEMARA Hamfest, P-105, S. Dartmouth MA 02748.*

VIRGINIA BEACH, VA
SEPT 16–17

The Tidewater Radio Conventions, Inc., is sponsoring the 1989 ARRL State Convention at the Virginia Beach Pavilion. Advance admision $5, $6 at the door. Features ARRL & DX forums of all types, major commercial exhibitors for amateur radio and computers, VEC Test sessions for all classes, indoor fleamarket , free parking. Talk-in: 146.37/.97. *Manny Steiner K4DOR, 3512 Olympia Lane, Virginia Beach, VA 23452. (804) 340-6105.*

PENNSAUKEN NJ
SEPT 17

The South Jersey Radio Association will sponsor its 41st Annual Hamfest at the Pennsauken High School parking lot. VEC license testing, all classes. K2AA talk-in: SJRA Rptr 145.290/.600. Advance tickets $3.50, $4 at the gate. Tail gate space, $5. Send with SASE to *Ed Ramming AB2Y, 4500 Westfield Avenue, Pennsauken NJ 08110. (609) 663-5539.*

OLD WESTBURY NY
SEPT 17

The Long Island Mobile ARC, Inc., will hold its Hamfest at the New York Institute of Technology. Admission, $3 at door, exhibitors $5. Talk-in: 146.25/.85. Contact *Neil Hartman WE2V, (516) 462–5549 or Mark Nadel NK2T, (516) 796–2366.*

OXNARD, CA
SEPT 23

The Ventura County ARC Swapfest will be at the Oxnard Community Center. Buyers free. Seller's tables, $7.50. All indoor. *VCARC, PO Box 2103, Oxnard CA 93033* or call *Dick WA6JOX, (805) 485-4462.*

BELLEFONTAINE OH
SEPT 23

The Champaign-Logan ARC will be holding their "Hamboree '89" at the Logan County Fairgrounds. Advance tickets $3, $3.50 at the door. Tables, $4. Free parking. Call-in/Directions on 147.60/.00 reptr. *Steven Kidder N8ETD, Box 265, Russells Point, OH 43348.* Or call *(513) 843–6006.*

GRAYSLAKE IL
SEPT 23–24

The Chicago FM Club will sponsor Radio Expo 89 at the Lake County Illinois Fairgrounds. Camping & parking available. Overnite security provided. Indoor flea market tables & electricity. VE exams. Advance, $4; $5 at door. Talk-in on 146.16/.76. *Mike Brost WA9FTS, PO Box 1532, Evanston IL 60204.*

ADRIAN MI
SEPT 24

The Adrian Amateur Radio Club is sponsoring its 17th Annual Hamfest/Computer Show at the Lenawee Fair Grounds. Advance tickets, $3; $4 at the gate. Full table, $6; trunk sales, $3. Talk in: 145.37–444.675. *Adrian Amateur Radio Club, PO Box 26, Adrian MI 49221.*

BERLIN VT
SEPT 24

The Central Vermont ARC is sponsoring the Fall Foliage Hamfest and Fleamarket at the National Guard Armory. VEC exams. Talk-in on 146.625. Admission, $2; tailgating, $4; tables, $6 in advance, $8 at the door. Handicapped accessible. *Todd Bigelow, PO Box 524, Williamstown VT 05679. (802) 433-5567.*

WILLIMANTIC CT
SEPT 24

The 7th annual Natchaug ARC giant flea market will be held at the French Club on Club Road. Dealers. Free parking. Admission $2, under 16 free. Advanced, inside tables $6, $8 at the door. Tailgating $5 and up. ARRL/VEC exams for all classes. Talk-in on 90/30. Contact *Pat Rogowski N1GBP, 90 Becker Circle, Windsor CT. (203) 522-8028 evenings.*

ELMIRA NY
SEPT 30

The Elmira ARA will present the 14th Annual Elmira International Hamfest at the Chemung County Fairgrounds. Outdoor flea market, indoor dealer displays of new equipment. Tickets available at gate or in advance from *Dave Lewis, RD #1, Box 191, Van Etten NY 14889. Don Estus, (607) 739–4807.*

NORTH WICHITA KS
SEPT 30–OCT 1

The Kansas State ARRL Convention will be held at the Red Coach Inn by the Wichita ARC. Features Flea market, dealers, VE Exams, forums, banquet Saturday night, breakfast Sunday morning. Talk-in: 146.22/.82 and 146.34/.94. Pre-registration $5, door $6. Flea market table, $6. *Vern Heinsohn WA0ZWW, 950 Backbay Blvd., Wichita KS 67203.*

Special Events Stations

PANAMA
SEPT 2–3

The Radio Club of Panama celebrates the 18th anniversary of their club with an HF-bands contest the hours of 00:01–23:59 GMT. Bands assigned: 15 mts; 20 mts; 40 mts. Contest callsign: CQ CONCURSO DEL RADIO CLUB DE PANAMA; CQ CONTEST FROM RADIO CLUB OF PANAMA. Authorized stations: HP1-LD; HP1-BSL; HP1-ECA; HP1-AIB; HP1-CDW; HP1-CDZ.

NEWNAN GA
SEPT 2–4

The Bill Gremillion Memorial Radio Club will operate K4SEX at 1400–2000 UTC in conjunction with the 20th annual Powers Crossroads Arts & Craft Festival. Suggested frequencies: 14.325; 21.325; 28.325. For QSL send QSL and SASE to *BGMRC, PO Box 2327, Newnan GA 30264.*

SCHAUMBURG IL
SEPT 3

The Schaumburg ARC will operate WB9TXO at 1500Z–2100Z from their demo station at Schaumburg Septemberfest. Suggested frequencies: 7.289; 14.289; 21.289; 28.389. For special certificate send QSL to *SARC, PO Box 68251, Shaumburg IL 60168-0251.* For info contact *John Seal (312) 887-1800 X-126 or (312) 830-8727.*

BILLINGS MT
SEPT 4–9

The Yellowstone Radio Club of Billings is sponsoring a special event to coincide with the Great Montana Cattle Drive to commemorate the Montana Centennial. Listen for stations identifying themselves as "The Great Montana Cattle Drive" with their individual callsigns. Hours will be 1400Z–2400Z each day. Suggested frequencies: 7265 kHz, 14265 kHz and 21365 kHz USB. For commemorative certificate send QSL with info and a 9 x 12 SASE to *Verlon Cox K7AEZ, 1124 Parkhill Drive, Billings MT 59102.*

LOST PENINSULA MI
SEPT 9–10

The Oliver Hazard Perry Expeditionary Force (WD8LKI) will begin operations from the Lost Peninsula Sept. 9th at 13H00Z. Suggested frequencies: 28.365, 21.365, 14.265, 7.265 and 3.965 MHz. To find the Lost Peninsula, send your QSL and a 9x12 SASE to *Como Wills, 30372 Bates Road, Perrysburg OH 43551.* For additional info contact *Robert F. Solon WD8LKI, PO Box 8526, Toledo OH 43623. Work (419) 475-8665, Home (419) 537-9255.*

Number 28 on your Feedback card

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

Names of nations. Burma has just renamed itself; it is now Myanma, with emphasis on the second syllable: Mee-ahn-ma. Cambodia, which became Kampuchea a few years ago, is Cambodia again. There have been many such name changes in recent decades, in Africa particularly. Perhaps we should do a rundown in a future column? With explanations, perhaps? Like, Upper Volta became Burkina Faso five years ago—why? Oh, well; we're lucky compared to school children in Myanma who have to learn that they live in the Pyidaungsu Socialist Thammada Myanma Naingngandaw.

Interested in inviting someone from the USSR to come visit? Bryan Hastings NS1B, Editor in Chief, *73 Amateur Radio*, is, and phoned the USSR Embassy. They responded by promptly sending him a short application in English and Russian. Those interested should write or phone the Soviet Embassy or Consulate in your country. (In the US, 1125 16th St. NW, Washington, DC 20036; (202) 628-8548.)

Radio broadcasting freedom continues to spread as, believe it or not, the Voice of America now has a Moscow Bureau with full-time staff. The once-clandestine Radio Liberty (RL) and Radio Free Europe (RFE) of OSS (Office of Strategic Services) and its successor, the CIA, now have in their employment a Moscow freelancer airing a regular review of what is in the Russian press, called "At the Kiosk." VOA even has talk shows which allow Russian listeners to call in with questions and comments. *Glasnost* is also permitting KOL Israel and Deutsche Welle to be heard. (From *The Economist*, and from *Die Zeit* in *World Press Review*.) Radio France International has announced a 45 percent increase in broadcasts to the USSR, Poland, Romania, and Yugoslavia; and Mr. Varbanskiy (first deputy chief of the USSR Ministry of Communications Space and Radio Communications Main Administration) has stated that equipment previously used for jamming now is used to shortwave relay programs to Moscow listeners. (From Robert Chear, France, and Karel Honzik, Czechoslovakia, in *Sweden Calling DXers*.)

In China, however, after two long steps forward there has been what we can only hope is just a single step back—but it was a tragic one. After the severe repressions in early June, a VOA correspondent was given 72 hours to leave the country. One can only wonder what the future will bring. References to the People's Republic of China in this column—if any—will be of a very general nature for a while. . . .

Reflections. When electricity replaced gaslight fixtures in the legislative chambers of the State of Washington, many legislators were nervous enough so that printed signs went up at the doors: Electric Lights Are Not Hazardous To Your Health.... I have a personal memory of the first time my grandfather used a wall crank telephone: He stood well away from the wall and yelled at it, meanwhile holding the receiver a safe six inches away from his ear.... In the 1930s a friend of mine got a letter from an acquaintance in Bogota, Colombia, saying he was going to telephone him on a certain date at a certain time, and what number should he call. To be sure everything worked out, my friend got a hotel room in Boston and alerted the staff. The manager himself supervised the hotel switchboard—and the call came in as scheduled after a series of operators exchanged their own messages. As he checked out the next day, the doorman asked him if his call had come in OK.... I gave my then-86-year-old father an electronic calculator ten years ago; It was weeks before he stopped checking up on its answers with pencil and paper—and he never had any real confidence in it.... As for me, as I reach 70, well, never mind! Let's just say I don't actually shake malfunctioning appliances in case the electricity has gotten clogged up in some wire somewhere . . . . RP

Yuri UA4LCQ/UG6 of Expedition SOS Armenia operating in the Leninakan/Spitok/Kirovokan area, December 1988–January 1989. (Photo from Ken Carpenter KC4UG.)

Calendar for September

1—Army Day, Chile
3—Independence Day, Qatar (7th for Brazil, 15th for Guatemala, El Salvador, Costa Rica, Honduras, and Nicaragua, 16th for Mexico and Papua New Guinea, 18th for Chile, 21st for Belize)
4—Labor Day, USA; Labour Day, Canada
6—National Day, Switzerland (10th for Belize, 11th for Chile, 26th for Yemen Democratic Republic)
8—**World Literacy Day.** Teach somebody "Have a good day" in *your* language today!
9—National Liberation Day, Bulgaria
12—Revolution Day, Ethiopia
15—Respect for the Aged Day, Japan
17—National Heroes Day, Angola
20—Federal Thanksgiving Day, Switzerland
23—National Holiday, Saudi Arabia
24—Anniversary of Third Republic, Ghana; Autumnal Equinox Day, Japan
25—Referendum Day, Rwanda
26—Confucius Day, Taiwan
30—Botswana Day, Botswana

Roundup

South Africa. The callsign for the Antarctica Sanae Research Center has been changed from ZS1ANT to ZS7ANT to make it more distinctive.

A radio amateur convention will be held in Johannesburg next March, according to Hans v. d. Groenendaal ZS6AKV, chairman of the Johannesburg Branch of the South African Radio League (SARL)—the largest of the SARL branches, with over 500 members. To be scheduled at the same time as the national AGM of SARL, it will have international guest speakers and seminars and discussion groups on many subjects including DX, packet, SWLs, and satellite operations.

The SARL publication, *ZS6TJ Calling*, was rated "Excellent" in Category A (publications of groups with over 500 members) in the 1988 *Amateur Radio News* Service Publications Contest.

Marlon Island background: For months before the Marion Island team departed last April for its planned 14 months of isolation, members received both specialized and general training, including psychological preparation for the experience. Peter Sykora ZS6PT (operating as ZS8MI) said he wasn't worried—he'd have plenty of work to do, including installation of an automatic weather-recording station. "There are after all seven of us," he said, "and I have Amateur Radio. I am sure that I will take time off to ragchew to my friends. . . . I hope the DXers will give me time off to have some leisurely QSOs!"

The Northern California DX Foundation provided two Yaesu FT757 GX2 transceivers, a FL2100 amplifier, and the power supplies for the DXpedition; Hal Lund ZS6WB provided an ICOM 8-metre transceiver, and two 4-el yagis. Peter will be using two rhombics and two V-beams also, which will be used for commercial operation between the island and Pretoria. He has an AEA PK232 TNC and IBM-compatible computer for logging and transfer of logs to ZS5E, his QSL manager. He hopes also to fire it up to work AMTOR and HF packet.

USSR. The reports we hoped to get from around the world on the

Armenian earthquake disaster never materialized, but see the photo for a picture of Yuri UA4LCQ/UG6 operating in the area.

ISRAEL

Ron Gang 4X1MK
Kibbutz Urim
Negev Mobile Post Office
85530 Israel

Callbook Foul-up. We don't know who is to blame, but in the 1989 *International Callbook* Israeli Novices who have upgraded have **Silent Key** listed next to their old Novice callsigns. Only the callsigns have passed on, and their previous owners now sport new calls that you'll have to search for elsewhere among the 1300 or so Israeli calls listed. *We can assure you,* those named next to the call-letters listed here (see the box) are alive and well!

All Novices are now 4X9s. The last stage of callsign restructuring has gone into effect. Novices used to be 4X4N- -, 4Z4N- -, and 4Z6N- -, with the N dropping out when they upgraded to Grade B (General Class). For a few years, the new Novices got a 4Z9- - - call, the ones with UHF all-mode privileges getting a 4Z9B- - ticket. The Ministry of Communications has finally recalled the old N- - calls, but gave no assurance that they wouldn't be reissued later—thus prodding the old Novices to upgrade! Prefix hunters may find the 4X9 calls on the Israeli Novice bands from 7.000 to 7.050 and 21.100 to 21.150 MHz CW, as well as (conceivably) on OSCAR Mode B, as Novice Enhancement here has given 25 watts output to all modes on the 70-cm band.

Alive and Well!
4Z4NZR, 4X6NDE, 4X6NFK, 4X6NFS, 4X6NKV, 4X6NRG, 4X6NRP, 4X6NUN 4Z9AAC, 4Z9ACD, 4Z9ADD, 4Z9AEB, 4Z9BBA, 4Z9BBC, 4Z9BCB, 4Z9CEB, 4Z9DBA, 4Z9DDD, 4Z9DED (*definitely not ded—ccc*), and 4Z9EAA.

Jerusalem's 4Z4SW, its only presently active club station, opened early in March. Rich 4X1DA was the moving force and Elmer, setting up the station at the Giloh Home for the Handicapped. Once a week he runs a class teaching residents to make QSOs on the air and steeping them in Morse code and radio theory. He had three hot prospects for exams in April. The station has a Kenwood TS-130 driving a 3-el tri bander 15 meters up on one of Jerusalem's higher spots. He is looking for volunteers to help out and bring more joy into the lives of the residents; anyone with time and good will is encouraged to get in touch with 4X1DA (previously 4X6DA).

Packet telephone. A packet BBS has been instituted by 4X4XX, 4Z4AB, and 4X6LM on "the twisted pair" for the use of IARC members, and can be accessed by dialing (03) 512–5396 daily between 1600 and 1730 local time, and from Thursdays at 1600 through Sundays at 0730. It works with a modem running at 1200 baud, and you don't need a ham license to access it! What can you find on the BBS? A mailbox, DX bulletins, technical articles, letters via packet radio, and files dealing with amateur radio. Why a BBS on the telephone? Shlomo 4X6LM says that it clears up the congestion on 146.675 MHz and lets those who don't have all the peripheral gear get in on the fun. And, finally, why not have one?

The Silent Keys' Forest is three years old now, and there are three thousand saplings growing there. It is in the Ben Shemen forests, about five km east of the Ben Gurion International Airport. The Israel chapter of the Quarter Century Wireless Association (QCWA) established the Amateur Radio Forest to provide a living memorial to our dear departed ones by creating forests on the hilly areas that had become bare from centuries of over-grazing and neglect.

The Ministry of Communications has issued the callsign 4X4SKF which may be used by any group operating a station there, and the IARC has activated the call on many occasions when field days or picnics have been held in the forest.

Hams and families all over the world as well as in Israel are invited to plant trees in the Silent Keys' Forest. The procedure is as follows: Send a check for US $5 for each tree you wish planted, payable to the Keren Kayemet Le'Israel (The Israel Forestation Authority). Write on the back of the check or on a separate piece of paper the name and callsign of the amateur to be remembered, and the name and callsign (if appropriate) of the donor. Mail it to the Authority, attention of Mrs. Vicky Alkalay, PO Box 283, 91002 Jerusalem, Israel. A handsome certificate suitable for framing and hanging on the hamshack wall will be sent to the donor. (Israeli donors should check to see if the current six-shekel donation per tree is still the right amount.)

Shimshon 4X4GF (Gefilte Fish) has suggested that 70 trees would make a most fitting donation. 73s—get it?

The annual IARC social event saw some 650 people gathered together in a banquet hall that two hours before the event was empty. Around 20 IARC volunteers then went to work putting tablecloths on bare tables, unloading hundreds of kilos of food and soft drinks from 4X4AT's van and prizes from 4X6OM's tender, and setting up the stage and sound system. At the appointed hour, the place looked as if professional caterers had been at work. (IARC members note: if you have been taking the organization's services for granted, now you know what goes on behind the scenes!)

The IARC General Secretary, 4X1AT, and 4X4AH, the honorary president, spoke, as did Monya Adan, an Old Timer radio pioneer who related tales of early communications networks in the settlements of pre-State Israel. In 1924, semaphore flags were used by day and flashlights at night, but during the Arab riots a wireless net was established. The British Mandatory authorities required a license to own a radio receiver, and transmitters were illegal, with hanging being the maximum punishment for getting on the air.

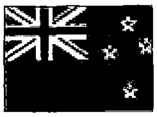
A private company in Tel-Aviv began building transmitters for the clandestine use of the Hagana (the Jewish Defence Organization), but there was trouble with the rigs, and as Monya became interested in radio, he studied amateur radio literature and started building small transmitters that became the backbone of the 1938 Hagana radio network. The network coordinated the illegal immigration operation, running the British blockade of the coast of Palestine and bringing in refugees from Hitler's death camps in Europe.

Monya issued himself the callsign ZC6MOM, one of quite a number of pirate ZC6s, and a friendly British officer, a ham, surreptitiously brought them QSLs!

Egan Ron 4X4RE (ZC6RE in 1947), issued Israeli passport #2002, told of organizing a DXpedition to the island of Rhodes in 1952 which didn't work out, but in 1956 when Israel occupied the Sinai Peninsula, he received the callsign 4X5RE, made 800 contacts from Sharm-el-Sheikh, finally completing a successful DXpedition. However, the DXCC did not recognize the operation! You can't win!

The long-awaited raffle followed the program. The stage was loaded with the goods obtained by IARC volunteers who had been pestering prospective donors for months. The best prizes were two airline flights overseas, a Mediterranean cruise, and two 2-meter handie-talkies from ICOM and Alinco, newcomer firms to the Israeli ham market. The bottom line was that income from the draw was sufficient to pay for the cost of the evening!

Prizes and gifts at the annual IARC social evening. At back, L to R, 4X6KJ, 4Z4AB, and 4X1MK. A happy winner slips into the photo, foreground, unexpectedly. (Photo by 4X1GE.)



NEW ZEALAND

Des Chapman ZL2VR
459 Kennedy Road
Napier
New Zealand

NOTE: A new address for the NZART National QSL Bureau: PO Box 35-046, Naenae, Wellington, NZ.

From June 1 of this year through to 19 February, 1990, ZL amateurs may use the callsign prefix ZM to promote the XIV Commonwealth Games to be held in Aukland in early February, 1990. Furthermore, there will be a special "Games" station, ZM14CG, established in the "Games Village" and staffed by members of the Auckland branches of the New Zealand Association of Radio Transmitters (NZART). The station will issue a special commemorative QSL card for contacts made with it. Operations will be on all bands, and visiting amateurs will be welcome at ZM14CG.

For further information, write Robert Jeffares ZL1BTR, 34 Amy Street, Ellerslie 1105, Auckland NZ.

The XIV Commonwealth Games Award, sponsored by NZART, will be available to radio amateurs worldwide. It is also a part of New Zealand's 150th Year Celebrations. Contacts between last June 1 and 10 February, 1990, will be eligible, and the requirements are as follows: Contacts with five (5) ZM1 stations, one (1) each with ZM2, ZM3, and ZM4 stations, plus one (1) with a Commonwealth country in each of Regions I, II, and III for a total of eleven (11) contacts. Logs must be verified and certified by two other amateurs, and sent to The Commonwealth Games Award Manager, Aola Johnston ZL1ALE, 63 Red Hill Road, Papakura 1703, NZ.

Terry Carrell ZL3QL has been re-elected NZART President by a large majority vote of the members. New councillors also were elected, and the new team met for the first time June 3/5. 73

QRP

Continued from page 81

the shaft to the capacitor, using a cut-off piece of pot shaft and some five-minute epoxy. I sanded both surfaces to rough them up, allowing the epoxy to get a better hold on the metal. Be sure that both pieces are clean and free of oil.

You'll need to go through a trial and error process to get the right length of shaft. I used some double-sided tape to secure the capacitor to the cabinet. You might want to try more epoxy to glue the capacitor down. A bit more work and you could mount the capacitor to a small piece of copper PC board, then mount the board to the cabinet. The choice is up to the individual builder—use whatever method works for you. Just be sure that you don't thread a longer screw than is supplied into the capacitor. This will short out the plates and ruin the variable capacitor.

In the old days, you could use a panel-mounted bearing to hold the shaft. Now you just can't find these bearings anywhere. So, I used a rubber grommet. This worked quite well, even though it was a bit loose.

Testing

Check over your wiring. Since there is not much to go wrong, we can move right up to testing out the meter. Couple a small amount of RF to the telescopic antenna. (I just placed the antenna near my open-line feeders.) Key up the transmitter and adjust the tuning capacitor for a peak meter reading. Make sure that you've got S-1 set to the proper range. Of course, don't tune up on the air except for short durations. That's about all there is to it! Tuning up that antenna for Field Day should now be much easier. I'm sure that the tuned field-strength meter will find a home in your tool box.

New from Ten-Tec

Some of the highlights of the new Ten-Tec Argonaut II: PLL tuning, 25 memories, LCD display, general coverage receiver, all ham bands (WARC), VOX, noise blanker, key pad input of frequency, five Watts input, and of course the famous Ten-Tec QSK CW. The Argonaut II is much smaller than the original. You can put one inside a small briefcase for some spy radio operation. Look for a review of the new Argonaut II in a upcoming issue of *73*. List will be around $900.

I'm very glad to see that Ten-Tec came out with this new QRP radio. As most of us know, Ten-Tec started out with QRP and has always led the pack with quality products for the low power operator. I wish them the best of luck with the new transceivers. Remember, you read about the new Argonaut here first!

Heath HW-9 Mods

I'm still looking for modifications for the Heath HW-9 for the third edition of the *Hot Water Handbook*. Send them to me at the address above. If I use yours in the book, you'll receive a free copy! Don't worry about the modification being too simple or too complex. I'm interested in all of them.

Until next month, slow those electric meters down! Operate QRP. Split logs, not atoms.

LETTERS

From the Hamshack

Zap!

The article featured in the July issue titled "Microwave Oven Transmitter" indicates it is time for your staff to get a "check-up from the neck up!" Building and/or operating this instrument of destruction subjects not only the operator but also innocent people to irreparable if not fatal microwave radiation. Commercial studio transmitter links usually don't run in excess of 10 watts, yet you offer the means of 500! Operating such a device within city limits without a doubt poses a health hazard to any living creature and will destroy the credibility of the amateur radio fraternity. Many "dish" ordinances which were overruled would now have the grounds to be reinstated.

Proper operating practices dictate using only the amount of power required to establish the contact. Your article contradicts this very basic guideline, where at 10 GHz contacts of several hundred miles were made with power levels of 1 watt or less!

I think it's time to use a bit of editorial common sense and trash articles of this type.

Please inform me as to which issue I can expect to see plans for a thermo-nuclear device. This will prove very useful to those studying the electro-magnetic pulse generated by these devices.

Bob Kozlarek WA2SQQ
Elmwood Park NJ 07407

Bob, we share your valid concern—hence the stern warnings in the article about the danger involved in building and operating the microwave oven transmitter. Comparing it to a thermo-nuclear device, however—even with your edge of black humor in it—is far-fetched!

Put matters into perspective. There are many devices in regular use in our society as dangerous as, or more so than, the microwave oven transmitter—cars and guns to name just two. Just as licensed drivers and (at least some) gun-owners earned the right to operate their devices, hams earned the right to transmit on a given set of bands with a given set of power out maximums—which for 13cm is up to 1000 watts. The FCC obviously considers us responsible enough to safely handle this.

As it turns out, there are times when several hundred watts is the minimum power required to make the contact—notably in Earth-Moon-Earth (EME) work. Path losses in 13cm EME work are enormous—typically 278 dB, when the moon is at apogee. The first design consideration that the 1989 ARRL Handbook (page 23-28) gives for EME work is that "transmissions must be made on CW or SSB with as close to the maximum legal output as possible."

Even though our microwave bands face a very serious threat from spectrum-hungry commercial interests, most are still virtually unused. High cost and hard-to-get components have long been problems—which the microwave oven transmitter project neatly eliminates on 13cm. There's more reason than ever for us to get active there—and the sooner the better! . . . *NS1B*

Advertising

I'm writing in response to Wayne's question posed in your editorial pages about allowing the Lambda Amateur Club to advertise for members in ham publications. I cannot for the life of me even see why this is being made an issue of. The Lambda club is not to promote their lifestyle or in any way recruit new homosexuals from the amateur community. What they are doing is simply let gay hams know of their existence and allow operators to seek more information on the club and its activities. And they have every right to do this.

Whether the group is straight or gay is irrelevant. What is important is that they work to promote the Amateur Radio Service and maintain high operator standards.

Robert A. Siddons NS2V
Margaretville NY 12455

Successful Proselytizing

For the time being, the code requirement exists for all license levels, and so the need to teach it. One effective method I found is to bury "treasure" and conduct a hunt. I bury a few dollars worth of coins in the city park and then hand out to interested kids tapes of directions, in slow code, to find the money.

Does it work? Yes! Competition from the peers helps plenty as well. If you want to try this, just keep the directions darned short! Good luck!

Michael Simmons WB9CWE
Charlestown IL 61920

UPDATES

Addresses for "Decoding OSCAR Telemetry"

In "Decoding OSCAR Telemetry," Parts I and II, by James Miller G3RUH, in the May/June 1989, issues of *73*, the following list of names and addresses for article references was inadvertently omitted:

AMSAT-NA, PO Box 27, Washington DC 20044. Tel: (301) 589-6062.

AMSAT-UK, 94 Herongate Road, Wanstead Park, LONDON, E12 5EQ, England. Tel: +44-1-989-6741. Accepts Visa/MasterCard.

AMSAT-VK, GPO Box 2141, Adelaide 5001, South Australia. Tel: +61-8-297-5104.

ARRL, 225 Main Street, Newington CT 06111. Tel: (203) 666-1541. Accepts Visa/Mastercard.

James Miller G3RUH, 3 Benny's Way, Coton, Cambridge, CB3 7PS, England. Tel: +44-954-210388. Accepts bank-draft, traveller's cheque, Eurocheque.

Pac-Comm Packet Radio Systems, Inc., 3652 West Cypress Street, Tampa FL 33607-4916. Tel: (813) 874-2980. Accepts Visa/Mastercard.

Project Oscar, PO Box 1136, Los Altos CA 94023-1136. Tel: (415) 591-4896.

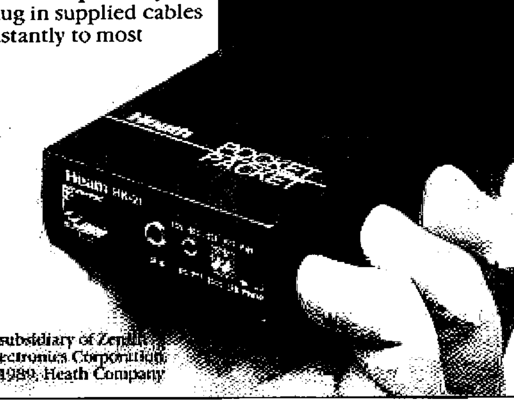
RadioKit, PO Box 973, Pelham NH 03076. Tel: (630) 635-2235. Accepts Visa/Mastercard.

UOSAT Spacecraft Engineering Research Unit, Dept. of Electronic Eng, University of Surrey, GU2 5XH, England. Tel: +44-483-571281.

"QRP CW Transceiver" Schematic

Note the schematic on page 21 of the June 1989 issue of *73*. The following corrections apply:

1. The schematic incorrectly shows a jumper from T2 to U2. It should go to U1. Note that this is only a jumper on the schematic and that there is no such corresponding jumper on the board.
2. C42 and R42 should be connected to pin 3 of U1, not pin 4. Pin 4 is open, except for its connection to pin 8.
3. The tap for L1 should be 8 turns up from ground.
4. The tap for L6 should be 8 turns up from ground.
5. The secondary winding for T2 should have 5 turns.
6. The drain of Q6 should be labeled. It is the lead connected to T3.
7. C47 is incorrectly listed on the parts list as 47 pF. It should be 47 mF.
8. An extra trimmer cap on the parts placement guide in the VFO is shown which is not assigned a value. Ignore this and the pads used to add capacitance to the VFO. It is not strictly necessary.
9. The layout shows C40 as 47 pF. It should be 47 mF.
10. The layout shows R13 as 10k. It should be 100k, although it is not critical.
11. C29 is shown on the schematic as an electrolytic, but not on the layout. It doesn't matter if it's electrolytic or monolithic, but if electrolytic is used, observe the polarity.
12. C2, the main tuning capacitor, is listed in the parts list as 35 mF. It should be 35 pF.
13. C23 is omitted from the parts list. It should be a 6–50 pF trimmer, just like C18.
14. There are several instances of 0.1 caps being listed as 0.01, and vice versa. All of these have been researched and the builder can use either. These values are not critical. 73

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Your Bulletin Board

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Needed: Schematic and manual for Eico Model 460 Oscilloscope. Will pay all copying, shipping, and handling costs.

Bob Bunn
Route 3, Box 565
West Plains, MO 65775

Wanted: Construction project on a linear amplifier using two or four 807 power tubes. If you know of such a project printed anywhere, please send a reply to:

Roland Torres KB5EQH
15519 Rio Plaza Drive
Houston, TX 77083

The Hernando County Amateur Radio Assn. of Brooksville, FL, is currently distributing FREE 1989-90 Florida 2m Repeater Directories. Ask for one at any official Florida Welcome Center located along the Interstate routes in Florida. You can also get one by sending a request and a self addressed, stamped envelope to:

Repeater Directory
Hernando County Amateur Radio Assn.
PO Box 1721
Brooksville, FL 34605-1721

I need advice on converting a Cobra 139XLR with the 858 PLL circuit to 10 meters. Please respond to:

George Ebersole KA3UQJ
536 New Street
Roaring Spring, PA 16673

Wanted: Regency Polaris NC6000 DF unit, or any information, parts, or manuals. Will buy, or exchange UK amateur or military radios, magazines, etc.

Bob Sayers G8IYK
120 Birmingham Road
Redditch, Woros, B97 6EP
United Kingdom

Wanted: Manual and schematic for the ICOM IC-701 transceiver, IC-701PS power supply, and the Hallicrafters FPM-300 transceiver. Will pay for copying and postage. Thank you.

Ralph M. Watkins NH6QT
92-952 Makakilo Dr. #74
Ewa Beach, HI 96707

I would greatly appreciate information on any modifications to improve function of Kenwood TS-830S. Will pay costs gladly. Thank you.

P. Triantafillou SV1ARA
Gounari 37
30100 Agrinio
Greece

Wanted: Manual or information on VHF Engineering RPT-432 repeater. Will gladly pay copying and/or shipping costs.

Steve Risinger NØIAX
3825 NE 92nd St.
Kansas City MO 64156
(816) 734-5657

I need the manual or instructions for the Heathkit Audio Analyzer model IM-48. I will pay copying and mailing costs.

Jim Brice KA3KUG
36 N. Jefferson St.
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PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
PO Box 1079
Payson AZ 85541

A Stormy Month

September's forecast is one of those in which I hope I am totally wrong, but I won't count on it! Propagation for this month will be very mixed up, indeed. Although September is the beginning of unusually excellent fall DX conditions—Solar Cycle 22 is rapidly approaching peak sunspot numbers—the HF bands may be very disturbed, to say the least, for much of the month. While solar flux will be high, you may expect exceptional activity in the form of flares, proton events, polar cap disturbances, and the like. These will have a definite effect on propagation. It's too early to tell what will be affected the most (this is being written in June), but use the chart of daily conditions for a guide.

Unusual weather conditions may also take place on many days of the month, and interesting geophysical effects may occur from time to time. Expect the earth's magnetic field to be unsettled to active, and up to storm levels on many days. Propagation conditions on the HF bands should improve remarkably in October, however, so we'll just have to grin and bear it for this month. Keep a sharp lookout for aurora and unusual VHF propagation on 6 meters and above. 73

EASTERN UNITED STATFS TO

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15*	20	20	20	—	—	—	—	—	—	—	15*
ARGENTINA	15	15	20	20	40	—	—	10	—	—	10	10
AUSTRALIA	10	15	20	20	—	40	20	20	—	—	—	10
CANAL ZONE	15	40*	40*	40*	40*	—	20	10	10	10	10	10
ENGLAND	20	40	40	40	—	—	20	10	10	10	15	20
HAWAII	10	15	20	20	40*	40	20	20	—	—	—	10
INDIA	20	20	—	—	—	—	—	15	—	—	—	—
JAPAN	15*	20	20	20	—	—	—	—		—	—	15*
MEXICO	15	40*	40*	40*	40*	—	20	10	10	10	10	10
PHILIPPINES	—	—	20	20	—	—	20	15*	15*	—	—	—
PUERTO RICO	15	40*	40*	40*	40*	—	20	10	10	10	10	10
SOUTH AFRICA	40*	20	20	20	—	—	—	—	10	10	10	15
U.S.S.R.	—	40	20	20	20	—	—	10	10	15	20	20
WEST COAST	10	15	20	20	[illegible]	[illegible]	—	—	—	10	10	10

CENTRAL UNITED STATES TO

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15	20	20	20	—	—	—	—	—	—	—
ARGENTINA	15	15	20	20	20	—	—	10	—	—	10	10
AUSTRALIA	10	15	15	20	20	40*	40	20	—	—	15	10
CANAL ZONE	15	15	20	20	—	40	40	10	10	10	10	10
ENGLAND	—	—	—	—	—	—	10	15	15	15	20	20
HAWAII	15	15	20	20	40*	40*	40	20		—	10	10
INDIA	—	20	—	—	—	—	—	20*	15	—	—	—
JAPAN	10	15	20	20	20	—	—	—	—	—	—	—
MEXICO	15	15	20	20	—	40	40	10	10	10	10	10
PHILIPPINES	15	—	—	—	—	—	—	20	10	10	—	—
PUERTO RICO	15	15	20	20	—	40	40	10	10	10	10	10
SOUTH AFRICA	20	20	20	—	—	—	—	—	10	10	15*	15
U.S.S.R.	—	—	20	—	—	—	20	15	15	15	20	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15*	—	20	20	20	20	20	20	20	—	15
ARGENTINA	10	15	15	20	20	20	—	—	10	—	10	10
AUSTRALIA	10	15*	15*	20*	20	20	40	—	—	—	—	10
CANAL ZONE	10	15	15	[illegible]	[illegible]	—	—	—	15*	10	10	10
ENGLAND	—	—	—	—	—	—	—	—	15	20	15	—
HAWAII	10	10	15	20	40*	40*	40	40	15	15	—	15
INDIA	—	[illegible]	—	—	—	—	—	—	[illegible]	15*	—	—
JAPAN	10	15*	—	20	20	20	20	20	20	20	—	15
MEXICO	10	15	15	[illegible]	[illegible]	—	—	—	15*	10	10	10
PHILIPPINES	10	10	—	—	—	—	—	—	20*	15	15	—
PUERTO RICO	10	15	15	[illegible]	[illegible]	—	—	—	15*	10	10	10
SOUTH AFRICA	20	20	—	20	—	—	—	—	—	10	15	15
U.S.S.R.	—	—	—	20	20	—	—	—	15	15	20	20
EAST COAST	10	15	20	20	[illegible]	[illegible]	—	—	—	10	10	10

* [illegible] (?) [illegible]

SEPTEMBER

SUN	MON	TUE	WED	THU	FRI	SAT
					1 F	2 F-P
3 P	4 P	5 P-F	6 F	7 F-P	8 P	9 P
10 P-F	11 F-G	12 G-F	13 F	14 F-G	15 G	16 G-F
17 F-P	18 P	19 P	20 P	21 P-F	22 F	23 F-P
24 P	25 P	26 P	27 P	28 P-F	29 F-P	30 P

73 AMATEUR RADIO

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OCTOBER 1989
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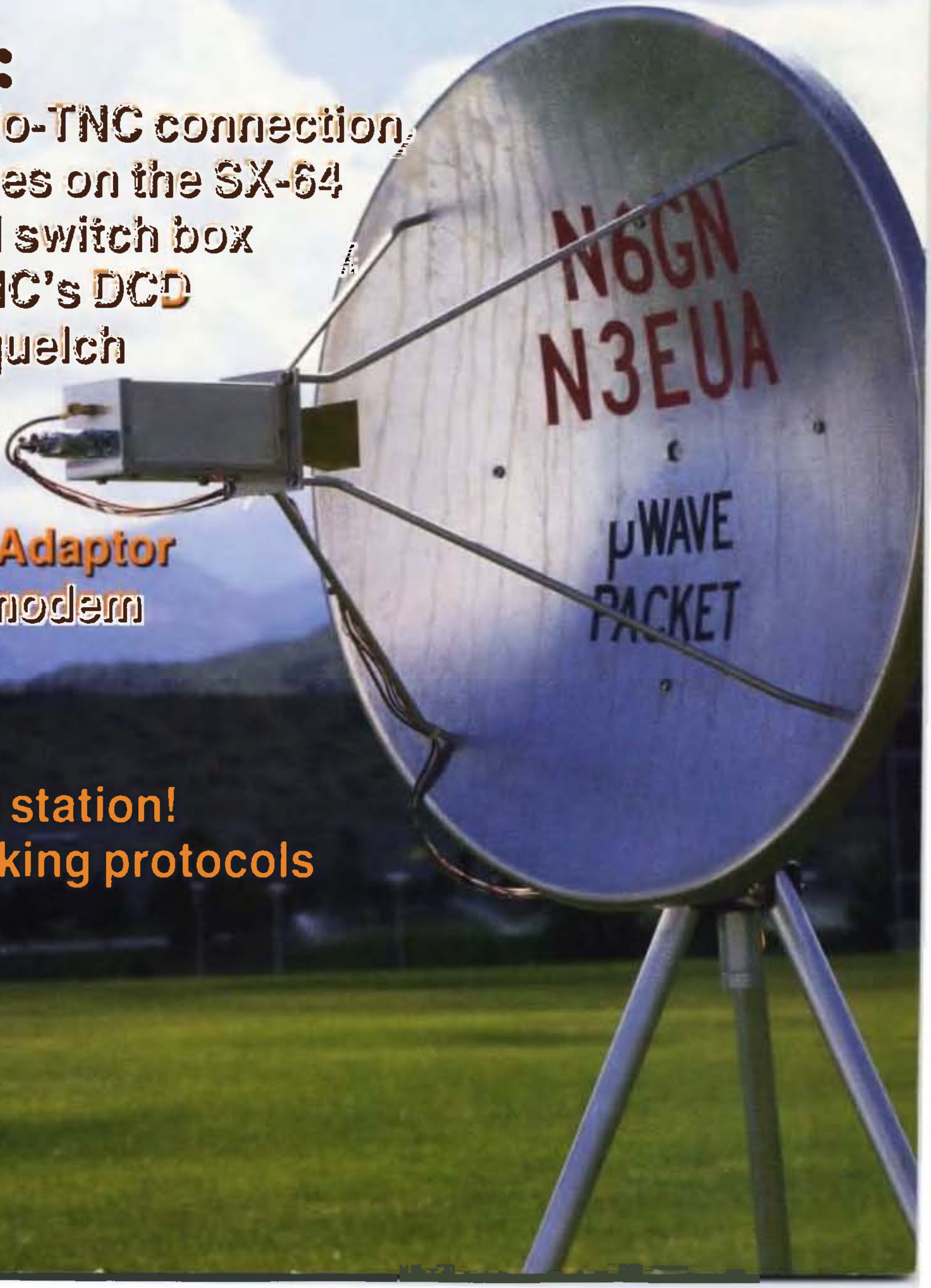
All about networking protocols



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73 AMATEUR RADIO®

OCTOBER 1989 Issue # 349

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FEATURES

HOME-BREW

REVIEWS

DEPARTMENTS

FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

10 GHz 1 Megabit per second packet station, designed by Bdale N3EUA and Glenn N6GN. See page 28 for more on this system. Cover by Alice Scofield.

"JS" VU2JX, a happy DXpeditioner to the Laccadives. Read about the trip on page 96.

Welcome, Newcomers!

[Words in bold face are those you will encounter frequently in the features in this issue, and in packet radio in general. . . .Eds.]

Welcome to the *73* Special Packet Issue, in which you will find nearly 40 pages devoted to the fastest growing aspect in amateur radio! What is **packet** radio? Like radioteletype (RTTY), amateur teleprinting over radio (AMTOR), and even Morse code (CW), packet is **digital** communications rather than voice communications. With packet radio, you can transmit any form of information that can be represented as digital (on/off or discrete values) information. A typical packet station contains only three items—a transceiver, a computer or terminal, and an interfacing device, usually called a **Terminal Node Controller** (TNC) or data controller, which links the rig and computer.

Features Unique to Packet

Packet radio works by collecting information and then transmitting it in bursts or packets. Each packet contains a special **error detecting code** that allows the receiver to determine whether or not the packet was damaged or changed in transit. Damaged packets are discarded by the receiver, and the sender then retransmits another copy of the packet. Each packet contains a source and destination callsign so that only the intended recipient will process the packet. This allows several packet "conversations" to go on at the same time on the same frequency.

The procedure followed by both the sender and receiver to ensure the transmission of information is called a **protocol**. The most popular protocol used in amateur packet radio is called **AX.25** because it is based on the worldwide computer networking protocol X.25.

Networking—Packet Radio's Newest Feature

Networking is a way of connecting computers together so that they can communicate efficiently. To simplify understanding of networking, its features are broken down into component levels or layers, each with its own general function.

Why use layers? Well, imagine that you are trying to understand how a car works. You probably will study individually the parts of the car—the engine, the transmission, the suspension, the electrical system, and so on. When you understand the function and features of each, you can more easily understand how it all fits together to form a car. Understanding the layers of a computer network works the same way; if you understand the functions of each layer, you can better understand the function of the entire network.

Much study went into defining the component parts of a network. The result is a scheme composed of seven components or layers.

These layers are named **physical**, **link**, **network**, **transport**, **session**, **presentation**, and **application**. The physical layer describes the way to move the raw data from one point to another and includes descriptions of such items as voltages, connectors, signal frequency, and the like. The physical layer in amateur packet radio typically uses narrowband frequency modulation (**NBFM**) radios to carry the signal. The digital data, the binary ones and zeros, are fed into a device called a **modem**, which converts the digital information into a signal that can be sent over the radio. The modem on the receiving end converts the signal back into the original digital signal for processing. The AX.25 link layer ensures that any errors that occur during the transfer process are corrected.

Packet communications works best when the physical link is good (very few errors) and AX.25 doesn't have much to do. Several articles in this issue deal with ways to physically transmit information faster, farther, and with fewer errors.

See the article "Amateur Radio Networking" in this issue for a fuller description of the network layers.

Until recently, packet radio was pretty much limited to point-to-point communications. There really wasn't a network layer to route the data to a distant station via intermediary stations. Neither was there a good transport layer to ensure that the message, when it reached the final destination, was accurate. There was no session layer to keep multiple activities (for example, a keyboard-to-screen chat and a file transfer) separated, and no presentation layer to hide the differences between computer systems.

Times have certainly changed. Now there is the Transmission Control Protocol/Internet Protocol (**TCP/IP**), the RATS Open System Environment (**ROSE**), TexNet, and **NET/ROM**. Each of these networking systems offers a different mechanism for moving packet information long distances.

Once there is a way of moving digital information long distances reliably, there is a desire to use that resource. Something that uses the network is called an **application**. The most common application (and up until now just about the only application) in packet radio is the bulletin board system (**BBS**). A BBS is a computer program that lets you use packet radio to send and receive electronic mail and bulletin messages. New applications are beginning to appear that permit someone to query about another ham, send or receive a computer program, or perhaps let your computer use the resources of a remote computer system.

Higher speeds, more reliable links, and better networking protocols will give rise to new applications. The 56,000 bit per second modem described by Phil Karn in this issue will make the computer-to-computer link comfortable. The 1,500,000 bit per second microwave packet system shown on the cover will make digital voice and digital amateur television possible. The bottom line is that packet radio is going to eventually affect every aspect of amateur radio, from chasing DX to providing better public and emergency communications service.

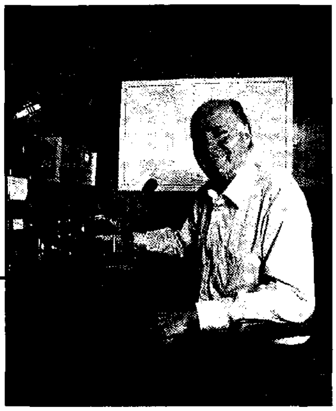
Now is the time for you to get involved with amateur packet radio. You can use it right now as an everyday aspect of your communications and you can get involved in experimentation and advancing the state-of-the-art. Either way, you will be challenged and delighted by this diverse and interesting facet of the exciting hobby of amateur radio.

. . .de WB6RQN

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



EMP Revisited

Seven years ago the FCC's Defense Commissioner, Mimi Dawson, with the support of Chairman Mark Fowler and Senator Goldwater, formed the Long Range Planning Committee (LRPC) with four National Industry Advisory Committees (NIAC) to assist it. The LRPC was made up of top executives in the communications industry, brought together to formulate an overall plan for emergency communications for our country.

The first step was to see what had been done in the past to cope with emergencies—what systems were available and how they had worked. The next step was to look closely at all communications systems and their role in helping us cope with future emergencies. Emergencies encompassed everything from local problems due to accidents, fires and floods, to regional emergencies due to earthquakes, right on up to the ultimate emergency: an atomic attack.

The LRPC soon had to face one fundamental fact: Only the amateur radio service had the potential for providing the needed communications. The military depended almost entirely on commercial telephone lines for their communications (95%)—and the first thing which seems to go out in any emergency is the telephone. Indeed, it was this which put the Alaskan military bases out of communications with the Pentagon for almost a week following the Alaskan earthquake. Their only communications were via hastily set up amateur radio networks.

The LRPC and the FCC then faced an extremely serious problem. If the only dependable emergency communications system which could tie together police, fire, towns, road crews, two-way services such as trucks, taxis and doctors, television remote units, CB, CAP, MARS, broadcast radio and TV, and so on, was amateur radio, then we were going to need a substantial growth and modernization of this service. The traffic volumes estimated were several orders of magnitude beyond the capability of our present voice or CW communications systems. These volumes could only be handled by high speed automated digital communications, such as packet radio.

The LRPC and the Commission then tried to tackle the need for vastly more hams. The only ham system in the world which seemed to be working these days was the one adopted by the Japanese—a no-code license. Efforts to implement this here were completely stopped by the ARRL directors. In frustration the FCC disbanded the LRPC and its NIAC committees, giving up on the whole emergency communications situation.

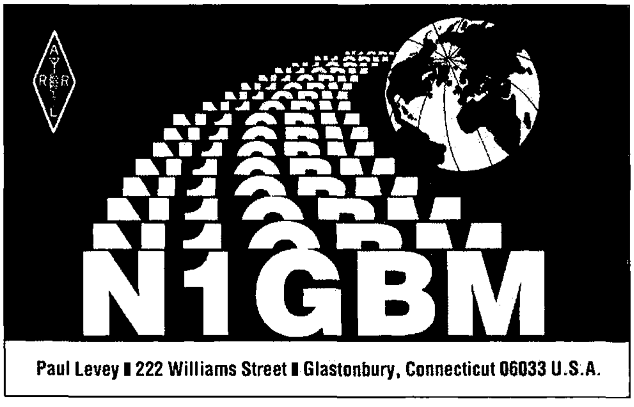
All this is the background and, my apologies since I've covered it all before, but I find many ham memories seem to be incredibly short when it comes to the no-code debacle. A couple of hams have been pushing the FCC to deal with the problem of electromagnetic pulses (EMP), so the few amateurs we have left will be in a better position to provide emergency communications should atomic bombs be used.

Little has been published on how we can cope with this problem. Indeed, we have little information on how much of a problem this really is! Some reports indicate that a high altitude bomb might wipe out most solid state equipment for a thousand miles around. Pffft would go all our HTs and mobile VHF gear—plus our low-band rigs—leaving us nothing with which to communicate. The Department of Defense (DOD) has been fighting to keep the FCC out of the EMP arena, saying there's plenty of information available on how to guard against EMP. The hams replied that the key information on this is classified—or, at best, apparently only available to large corporations.

Can ham gear be protected against EMP so we would have a chance to do our thing in case of an atomic bomb? Unless data is made available to help us shield and protect our ham stations, and to help manufacturers build in bypassing and shielding, the only backup communications our country has in case of such an emergency will be completely out of business.

Well, you say, the likelihood of an *atomic attack is remote* enough so all that is just the usual gloom and doom baloney. That's nothing I have to worry about any

Continued on page 74



QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock, NH 03449, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

QRX . . .

EDITED BY BRYAN HASTINGS NS1B

Kudos

. . . to Brian Lloyd WB6RQN, for coordinating this month's Special Packet Issue, and especially for his editorial contributions. His efforts in gathering the editorial material were key to the formation of this issue. Thanks very much, Brian!

Home-Brew IV Contest Results

The verdict is in for the top three articles for the Home-Brew IV contest! The four-member evaluation panel, consisting of Jeff DeTray NK1F, Perry Donham KW1O, Bryan Hastings NS1B, and Walter Lewandowski WA2VSN, spent many hours in late July carefully reviewing each candidate. The decisions were tough, as there were many fine entries from which to choose.

First prize went to Michael Geier KB1UM, for "Flavorig!", his inexpensive and simple conversion of a Radio Shack Flavoradio™ transistor AM radio to a 5 watt 80m CW transceiver. The second prize went to Ron Cole K4OND for the "Bitchaser," a totally home-brew comprehensive piece of test gear designed especially for digital circuitry. Third prize went to William Lazure KB5CTH for his elegant version of a stable sensitive 60 Hz–100 kHz frequency meter.

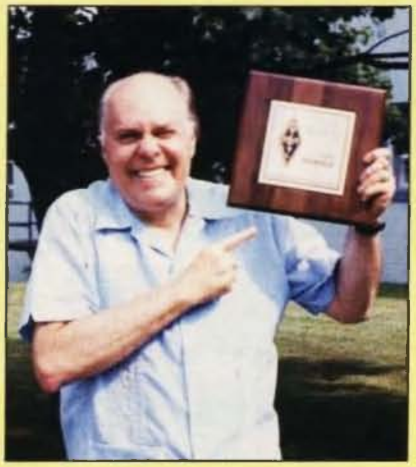
These top three articles will appear in the November 1989 issue. Thanks to all who participated! For those of you who didn't make it, be sure to look out for the announcement for the Home-Brew V contest in 1990.

Shockley SK

William Shockley, co-inventor of the transistor and Nobel Prize winner whose later life became embroiled in controversy over his racial theories, died of cancer at his home in Stanford, California. He was 79 years old.

Shockley shared the Nobel Prize for physics in 1956 with his colleagues from Bell Laboratories, John Bardeen and the late Walter H. Brattain. The team's first semiconductor device, developed in 1947, was an innovation that made the electronic age possible. Shockley Semiconductor Co., the company he founded after leaving Bell labs in 1954, was instrumental in the birth of the Silicon Valley electronics industry. His former employees later invented the integrated circuit and the microprocessor.

Shockley's later life was marked by bitter controversy over his claims that intelligence was genetically determined, and that blacks were genetically inferior and as a group could not be as bright as whites. His claims contributed to debate over the use of IQ tests in schools and over why black Americans failed to score as well as whites, an outcome most experts blamed on biased tests and other factors not related to genetics.



Guess who's a 50-year member of the League? Wayne W2NSD/1, "shows off" his plaque from the ARRL . . .

ARRL Pro No-Code

The ARRL is getting with the program at long last! Their Board of Directors ruled in favor of adopting a no-code license class. On 21–22 July, after an extensive and sometimes heated discussion, and by a vote of nine Directors in favor to six opposed, they agreed that the ARRL will present a proposal recommending a codeless class of amateur license to the FCC. This proposal for the new class of license—to be called "Communicator"—will be in the form of a petition for rulemaking.

The examination will consist of Novice-written Element 2 and an expanded Technician-written Element 3A having additional questions. These will include questions related to Morse Code.

All license examinations will be given through the VEC examination system. To upgrade to Technician, the new licensee must pass a five-word-per-minute Morse code test also administered through the VEC system.

Callsigns will be assigned from the Group D callsign block. Frequency privileges will be 220 MHz and above, with output power limited to 250 watts. The no-code licensee will not be allowed to be the control operator of a repeater or auxiliary station.

JA WARC Bands

Japan's amateurs now have full access to the 18 and 24 MHz WARC bands. In 1979, the ITU created three new ham bands at 10, 18, and 24 MHz. In 1982, Japanese amateurs were granted privileges on 10 MHz, but it was not until 1 July that the other two bands were opened to them. The 18 MHz band is restricted to Japanese First and Second Class license holders, but 24 MHz is open to all operators.

Put This In Your Pipe

A California ham is suing General Telephone due to their alleged discrimination against non-smokers. Craig Chambers WB6HTS of Los Angeles is making national headlines after filing suit against the giant telecommunications conglomerate. According to Chambers, not only was his request to be placed in a non-smoking environment denied, but he soon found himself called on the carpet by his superiors. He claims he was fired from his job after requesting a medical transfer to keep him away from tobacco smoke.

Let's hope hams and non-hams alike appreciate Craig's fight for the right to work in an environment that is free of tobacco smoke. Send letters of support to Craig Chambers, 2829 Warwood Rd., Lakewood CA 90712.

UK Murder

A ham and his wife have been murdered in England, and the police are asking hams to aid them in finding the killer. Peter Dixon G0HFQ and his wife Gwenda were last seen on Thursday, 29 June when they left on a camping trip to Howstone Farm near Little Haven in Pembrokeshire. Their bodies were discovered on 5 July. Both died of gunshot wounds and investigators say that they were killed within a half mile of their campsight. Dixon's car was equipped with both HF and VHF amateur gear. Police are asking any ham, anywhere in the world, that may have contacted G0HFQ between 29 June and 5 July to get in touch with them. Contact the Murder Incident Room of the Pembrokeshire Police at Haverfordwest 3721. The STD code is 0437. If you are calling from outside the United Kingdom, request operator assistance.

Merci Beaucoup

Thanks to ***Westlink Report, RF Carrier*, and Associated Press** for providing items for this month's QRX. **Keep your ham radio-related news items and photos rolling in to** *73 Magazine*, WGE Center, Forest Rd., Hancock NH 03449, Attn: QRX. You may also submit text as E-Mail to the Sysop on the the 73 BBS, (603) 525-4438, 300/1200 baud, 8 data bits, no parity, and one stop bit.

Packet Racket Lip Zipper

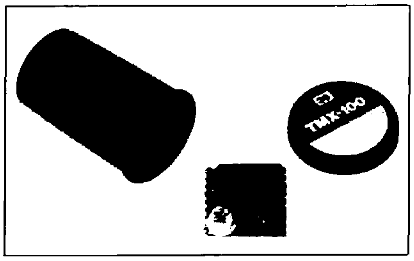
Automatically turns off your rig's speaker during packet operation.

by Michael J. Geier KB1UM

If you're like most of us frugal hams, you're using your 2 meter base rig for both voice and packet—and you're sick and tired of the awful packet screech and having to connect and disconnect cables every time you switch modes! Of course, you can solve these problems by buying another rig for packet, but why spend $500 when you can build the Packet Racket Lip Zipper for next to nothing?

The Lip Zipper switches the audio output of your rig from an external speaker (or even the internal one, if an interrupting connector is provided on the radio) to the audio input of your TNC. In addition, you can use it to switch the rig's mike input between the mike and the TNC.

A glance at Figure 1 reveals how simple the Lip Zipper is. It takes its power from the 12V supply powering the rig and/or TNC, drawing minimal current. It senses activation of the TNC from pin 9 of the DB-25 serial connector, then energizes the relay. (Pin 9 on my MFJ 1270 TNC is connected to +12 volts. If yours isn't, try using pin 6, the Data Set Ready connection. Anything that switches on and off with the TNC will do.) You can make the whole circuit from Radio Shack parts, and it will fit into a plastic 35mm film can or other handy container (see photo).



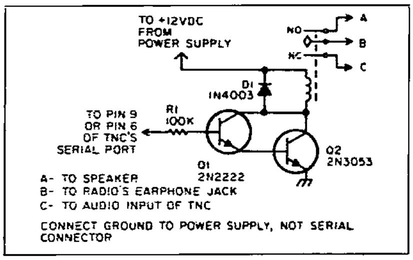


Figure 1. Schematic for the Packet Racket Lip Zipper.

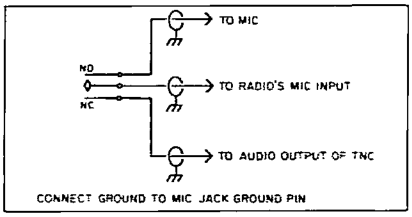


Figure 2. Optional circuit for switching between mike and TNC.

Construction

Use any construction technique you like. Nothing is critical here, although I do recommend shielded cable for all audio leads, including the speaker connections. Otherwise, RF hash from your computer can get into the TNC and cause problems. Of course, that can happen even without the Lip Zipper.

First, connect the sense wire to pin 9 (or 6) of the DB-25 on the back of your TNC. If you have a sealed, factory-made cable, you'll have to open its connector far enough to connect the wire. If that seems too difficult, you can open the TNC and connect to the PC board, running the wire out the back. But you'll void your warranty if you do it that way.

Connections to your radio will depend on its make and model. Some rigs, like my trusty old KDK FM-2016A, have an accessory plug on the back that lets you interrupt the audio going to the internal speaker. If yours doesn't, you'll have to use an external speaker. Many base station ops do that anyway, for the better sound.

Lip Zipper Parts List

Q1	2N2222	RS# 276-2009
Q2	2N3053	RS# 276-2030
D1	1N4003	RS# 276-1102
K1	DPDT	RS# 275-249
R1	100k	

When you're done, stuff the board into the container and put it out of sight. Since it has no user controls, you don't need it cluttering up the shack!

An Option

My accessory plug also has an audio input pin, originally intended for a DTMF pad. I connected it to the audio output of my TNC and it worked fine. It doesn't seem to mind that the mike is still connected, but if yours does, just use the optional circuit shown in Figure 2.

These extra connections let you switch the rig's mike input between the mike and the TNC, and they require you to get into your mike plug and add some wiring. Be sure to use shielded cable; the old "twisted pair" just won't do.

Powering Up

With the Lip Zipper installed, turn on your 2 meter rig, leaving the TNC off. Your mike and speaker should operate normally. Now fire up the TNC. The speaker should quiet immediately, and if you're using the optional circuitry, the mike should no longer work (although the PTT will still key the rig).

Sit back and enjoy the quiet and convenience of a dedicated packet station. When you're ready to return to voice operation, just switch the TNC off and you're back on the air! 73

Michael J. Geier KB1UM appears monthly as 73's Tech Answer Man in "Ask Kaboom." You can contact him at 7 Simpson Court, S. Burlington VT 05403.

Setting Up a Packet Radio Station

An excellent guide for beginners and veterans alike.

by Brian Lloyd WB6RQN

You may be just joining the packet radio revolution or you may have been using packet for a while. Either way, this step-by-step guide to setting up a working, reliable packet station is here to help you. You beginners, and those of you just getting interested, will find simple advice that's unavailable in any book. Those of you who are experienced packeteers will learn how to gauge the performance of your radio when you use it as part of your packet station.

What System to Put Together?

There are just a few components to the basic system—the transceiver, the terminal (or personal computer), and the Terminal Node Controller (TNC) or data controller. The TNC "interfaces" the rig and the PC—that is, it goes in-line between the two. The following few sections discusses these three components.

#1 - The TNC/Data Controller

Until a few years ago, the only interface was the TNC. Most TNCs contain two devices, a modem (MOdulator/DEModulator) and a packet assembler/disassembler (PAD). A modem is a device that converts the digital pulses from the computer to a form the radio can use to modulate a carrier wave, and vice versa. The PAD converts the data stream coming from the computer into discrete groups—called "packets"—which go on to the transmitter. It also converts the packets arriving from the receiver into a continuous data stream that goes on to the PC, which interprets the data as text and prints it onto the monitor.

Nowadays there's a little more selection. In the last few years, data controllers—devices that can encode/decode other digital modes such as RTTY, AMTOR, and CW in addition to packet, appeared on the market. These are also called multimode or all-mode controllers. Examples of these are the AEA PK-232, the MFJ 1278, and the Kantronics KAM. You just put them in in place of the TNC.

Even newer to the market are boards that plug into your computer to make it a complete packet radio system, except the transceiver. (See the review of the DRSI Packet Adapter in this issue.) The plug-in board approach is pretty much limited to the IBM-PC and compatible computer systems. Most of the plug-in boards offer an on-board modem so that the computer may be plugged directly into the radio. You won't need a cable or another piece of hardware.

If you plan to get into packet very seriously and/or are an avid experimenter, the plug-in board is probably the best way to go. It can also be the least expensive since many of these boards give you connections for two radios (it's like having two TNCs). The software available for the plug-in boards tends to be more powerful because it can take advantage of the computing power of the PC—a much more powerful computer than the TNC or data controller. If you want to operate on HF and you have chosen the plug-in board approach, don't worry; many vendors offer external modems optimized for HF operation, which you can attach to one of the serial ports on the plug-in card.

If you are interested in operating packet and you want to operate RTTY, CW, and/or AMTOR, choose a multimode device. They provide all the modes of operation and usually include a special modem and tuning indicator that is optimized for HF operation. When you select packet operation in any of the multimode devices they perform as ordinary TNCs.

If, like most packeteers, you plan to use packet on VHF for local communications, the TNC is your best bet. This is the traditional way to construct a station and, in many cases, is also the least expensive way to go.

#2 - The Transceiver

For VHF operation most packeteers use a standard VHF NBFM radio. Since most packet operation takes place on only a few frequencies, an old crystal-controlled rig is a good choice. On 2 meters, much of the packet activity goes on between 145.01 and 145.11 MHz.

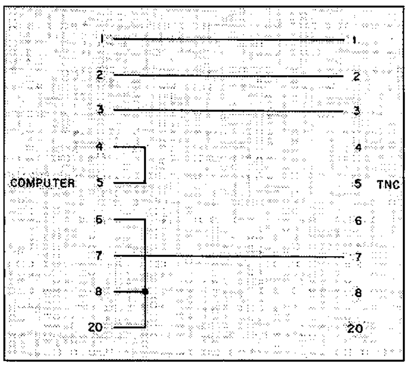


Figure 1. RS-232 cable pin connection between the computer and the TNC.

Consider also transmitter power. Packets need a good signal-to-noise ratio to get through reliably. It really doesn't hurt to have a 25W transmitter. A handy-talkie may be convenient but its 2W output can make a link marginal.

On the same token, it's especially important in packet radio to have a good receiver and antenna. You should be able to hear those stations that hear you. This is because packet is a simplex mode—it operates on only one channel. Thus, a packet station listens on the channel and does not transmit until it senses that the channel is clear. If two or more packet stations transmitted on the same channel simultaneously, then those packets would "collide," causing their corruption. For packet to work well it is important to hear all the other packet stations in your area. If your system can't hear another station, it may think the channel's clear when it may actually be busy, and so transmit, causing a collision.

Effective HF packet operation requires a very stable rig that can be tuned within 20 Hz of the desired operating frequency. If you have an analog rig, consider crystal control for the frequencies you plan to use. (HF packet tends to operate on just a few frequencies). If you have one of the newer digital rigs that use a PLL for frequency control, consider getting the high accuracy option (usually a temperature-compensated crystal oscillator or a crystal oven).

You want also to have a good 500 Hz bandwidth receiving filter. Filters in the modem are no substitute for a good crystal or mechanical filter in the receiver's IF. For best performance, AGC sampling must take place AFTER the selectivity, not before. If you use a wide filter, an unwanted signal in the receiver's passband can cause a change in the receiver's AGC even though the signal doesn't otherwise interfere with the packet signal you are trying to receive. The gain change can confuse the modem and make the packets unreadable.

Packet, like AMTOR, likes a fast transmit/receive switching time on the radio. The receiver must recover very quickly after transmitting so you can reliably receive the acknowledgments from the other station. Although a slow transceiver can be made to

work, it requires both stations to make adjustments in the transmitter keyup delay value (TXDELAY) in the TNC. (See the discussion on setting TXDELAY later in this article).

#3 - The Computer or Terminal

If you acquire a TNC you need a computer or a computer terminal to display the data. If you choose to use a computer terminal it should be capable of asynchronous ASCII operation. A terminal usually has everything you need to communicate with the TNC built-in, so all you need to connect the terminal to the TNC is a cable (see below).

Computers are inherently dumb and must be told what to do by software programs. If you are operating with a multimode device or a TNC you need a program for the computer that allows it to operate as a terminal. Most vendors of TNCs and multimode devices offer programs for the more popular computers. These programs are tailored to packet operation and include features that make operating packet radio more efficient, simple, and enjoyable. On the other hand, almost any program designed to allow the computer to operate with a modem—such as Crosstalk or Procomm—works fine.

If you get the add-in board you'll need some special software. This software should come with the board, usually in the form of one or more computer diskettes. Some boards have publicly-available software.

Connecting the TNC to the Computer

If you choose the add-in board approach, the connection is handled internally in the computer. The manufacturer's instructions tell you how to properly configure the jumpers or switches on the board.

If, however, you have a TNC or multimode controller, obtain a cable to connect the device to your computer or terminal. In order for your personal computer to "talk" to a TNC, make sure that it has true asynchronous RS-232 serial port. (Some less expensive computers do not adhere to RS-232 signal level specs. These computers may not work well with some types of TNC.) A serial port is one that accepts digital data serially—that is, one bit at a time. Most serial port connectors on computers are either DB-25 males or DB-9 females. Then buy or configure an RS-232 cable with the appropriate connectors.

Some computers, such as the ever-popular Commodore-64 and the VIC-20, have TTL signal levels at their serial ports. You have several options here: find a TTL/RS-232 level converter interface, or get a TNC/data controller that uses TTL signal levels rather than RS-232.

The simplest cable for connecting the TNC to the terminal requires only three signals: transmit data, receive data, and ground. On a standard DB-25 RS-232 connector these are pins 2, 3, and 7, respectively. Try the "three wire" connection first to see if it works. Connect the TNC to the terminal, turn on the terminal, then turn on the TNC. Something should appear on the screen (although it may be random "garbage" characters). If you get absolutely nothing on the screen, your terminal or computer probably requires some of the RS-232 control signals in addition to the transmit and receive data signals. Try connecting the signals "Data Set Ready" (pin 6), "Data Carrier Detect" (pin 8), and "Data Terminal Ready" (pin 20) together at the terminal/computer end of the cable. You should now get something on the screen when you turn on the TNC.

The next step is to ensure that the computer/terminal and the TNC are sending data to each other at the same speed (baud rate) and format. Most packeteers use 4800 or 9600 bauds between the TNC and the terminal with 8 data bits, no parity, and one stop bit. Set the terminal or your terminal program to the desired baud rate and these parameters. Some TNCs have a switch on the back that lets you set the data rate. In that case, set the baud rate on the TNC to the desired value.

Some TNCs have no external switch for baud rate. These TNCs have an autobaud routine that automatically determines the baud rate used by the terminal. Usually you wait until a legible message from the TNC appears on the screen of your terminal, then you press a specific key on the keyboard. At this point there should be communications between the TNC and the terminal in both directions.

Sometimes your terminal can see what the TNC is sending but the TNC appears to ignore everything you type. This is usually a problem with the RS-232 connection. If this occurs, try connecting the "Request To Send" signal (pin 4) to the "Clear To Send" signal (pin 5) at the terminal or computer RS-232 connection.

At this point the terminal and TNC should be communicating. If every character you type appears twice on the screen, set your terminal or computer for full-duplex operation.

This is a good time to set the terminal control parameters of the TNC. Every TNC or multimode controller has some preset or default values for its control characteristics. You can change these parameters to make the TNC more compatible with your terminal. If you are using a CRT terminal or a computer, enter the command BKONDEL ON. After this command the TNC erases characters on the screen when you press the backspace key on the keyboard. Some terminals generate the ASCII rubout (delete) code instead of the ASCII backspace code when the backspace key is pressed (DEC VT-100 and compatible terminals). You can tell that this is happening if you make a mistake then correct it with the backspace key, and the TNC does not recognize what appears to be a perfectly valid command. You can tell your TNC to recognize your backspace key with the commands DELETE $7F or DELETE ON. Read the manual that comes with your TNC to find the appropriate command.

Many terminals and terminal programs provide some sort of line wrapping function. This means that if you type beyond the end of a line your typing continues on the next line. The TNC also provides this feature. If both are turned on, you see text on every other line whenever the text extends beyond the end of the line. To prevent this, either turn off the line wrapping at the terminal or send the following command to the TNC: SCREENL 0.

This is the time to experiment with sending commands to your TNC. You can get a feeling for how it works before you hook it up to the radio.

Connecting the TNC to the Radio

Perhaps the single most important thing you can do to ensure reliable packet operation is to properly connect and adjust the TNC to the radio. First, decide where to connect the two. Many transmitters offer a high-level auxiliary input. Use this input instead of the microphone input if possible. Many microphone inputs do some equalization or signal processing that can distort the signal generated by the TNC thereby making it difficult for other stations to decode your packets. The signal at the aux input often bypasses these stages and provides better performance.

The audio from the receiver needs to get to the TNC. Although the signal from the speaker may work, it is almost always distorted by the audio amplifier. The result is that the TNC fails to decode otherwise good packets. Many radios offer a low-level audio output for a phone patch or selective calling unit. This low-level output is a much better choice than the speaker jack. If your radio does not offer a low-level output, try taking the signal from the "hot" side of the volume control.

Once you have the TNC connected to the radio, adjust the transmit signal level so that the signal from the TNC properly modulates the transmitter. Proper adjustment here is critical for good results. There are two techniques for setting the transmit level of an NBFM transmitter.

The first technique requires a deviation meter. Set up the deviation meter to read the deviation of the transmitted signal. Turn on the transmitter and the TNC and enter the calibration command. If your TNC offers the option of selecting either the high or low tone, select the high tone and adjust the signal level at the TNC for 2.5 to 3 kHz of deviation. If your calibration command alternates between the mark and space tones at a rapid rate (Kantronics' calibration command does this) set the level at the TNC for 2.0 to 2.5 kHz of deviation.

The second technique does not require a deviation meter but it does require a receiver and an AC voltmeter. Connect the voltmeter to the output of the second receiver so that you can get a relative indication of audio output. Set the frequency of the receiver to the output frequency of your TNC/radio pair. Turn on the transmitter and the TNC and enter calibration mode. Select the high tone and increase the TNC's transmit signal level until further increase of the level at the TNC no longer results in an increase in the level indicated by the AC voltmeter connected to the second receiver. Note the reading on the voltmeter. Now decrease the signal level at the TNC until the voltmeter connected to the

Continued on page 18

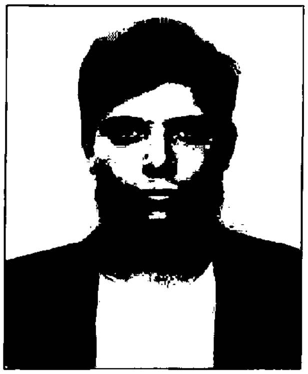
Number 6 on your Feedback card

HAM PROFILES

There are no "average" hams!

Career Aims Shaped by Radio Theory

Elan Grossman KA2RMW, age 20, got his ham ticket at age 14, after enrolling in Carole Perry WB2MGP's course at Intermediate School 72 in Staten Island, New York. He is presently an undergraduate at Wesleyan University, majoring in both physics and astronomy. He just finished a research apprenticeship at Wesleyan's Van Vleck Observatory (which houses the largest telescope in Connecticut) working on a project to study physical properties of stars under formation and to search for possible planets around them. Elan also works with a 20-inch Alvan Clark refractor that records the apparent parallax shift in nearby stars, a way of determining their distances.



Elan Grossman KA2RMW—a young ham active in astrophysics.

Elan is also part of a project under grant to conduct research on a new form of radiation detector that would be able to measure the quantity of radiation to which a person has been exposed. He also taught gifted high school youth during the summer.

Elan's future plans include a Ph.D. in either astrophysics or planetary science. He says the knowledge he gained in radio theory played a significant role in shaping his interests in electrodynamics and radio astronomy.

Young Ham of the Year

Erin McGinnis KAØWTE, age 18, of Topeka, Kansas is this year's *Westlink Report* "Young Ham of the Year." This Tech licensee was chosen for this high honor because of her ongoing dedication to amateur radio public service activities, disaster preparedness work, and publicization of amateur radio. She regularly participates in civic events such as net control for the Washburn University President's Rowing Regatta, the Annual Railroad Days Commemorative, and the Exxodusters Parade. Erin also displays amateur radio at emergency preparedness exhibits, is a regular member of the local ARES operation, and participates in each Field Day.

Erin organized press releases and interviews for the local and the national electronic press, and assisted in the preparation of a city resolution declaring Field Day to be "Kaw Valley Amateur Radio Club Week" in Topeka. She also organizes and teaches the club's fall Novice training class.

Erin is a recent Honor Roll graduate of Topeka High School where she maintained a straight

Erin Mc Ginnis—Young Ham of the Year.

"A" average during her Senior year. High school activities included dramatics, drill team, debate squad, various social functions and, of course, amateur radio. She also held a part-time job.

Erin comes from an all-ham family: Her father is Steve NØHGX, her mother is Linda NØHGY, and brother Matt is KAØWTF. Her primary ham interest is chatting with the British Isles. She intends to use amateur radio to keep in contact with her family from Emporia State College.

FEEDBACK

In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers, which appear on each article/column and are also listed here. These numbers correspond to those on the feedback card opposite this page. On the card, please check the box which honestly represents your opinion of each article or column.

Do we really read the feedback cards? You bet! The results are tabulated each month, and the editors take a good, hard look at what you do and don't like. To show our appreciation, we draw one feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*.

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Continued from page 16

receiver reads about six to seven tenths of the maximum reading previously noted. Your deviation is now set.

Kantronics seems to be a special case when it comes to setting the signal level coming from the TNC. The Kantronics unit uses a jumper rather than a trimpot for setting the signal level. The result is that you have only three choices for signal level. You may well need to change one of the resistors that determines the transmit signal level. In my KPC-2 I replaced the resistor with a trimpot so that I could vary the level according to need.

Getting On The Air!

If you have performed all the steps up to this point your station is ready to put on the air. Now it is time to enter the control commands for the TNC (the add-in boards have their own unique command set so you need to determine on your own which parameters you need to change). Here is a verbatim list of commands to enter: AX25L2V2 ON, MAXFRAME 1, MYCALL WB6RQN (put your own call in on the last command).

The first command enables the later version of AX.25. (AX.25 is a "protocol" agreed on by many packet stations.) The second command allows the TNC to send only one packet before waiting for an acknowledgment. The last command sets your callsign in the TNC (some TNCs will not operate until you enter your callsign).

The next step is to determine the proper setting for the TXDELAY command. TXDELAY determines how long the TNC waits after keying the transmitter before it actually begins sending data. This value is different for every radio and you must take into account the amount of time that it takes for the transmitter to turn on and for the remote receiver to begin decoding your packets. The default value for TXDELAY is usually 300 ms. This means that the TNC begins sending data 300 ms after the TNC keys the transmitter. For voice this is a pretty short time but for packet it is quite long. It is a good idea to try to shorten this time if possible.

Determining the proper value for TXDELAY is not difficult and takes only a few minutes. It requires two stations so it is probably a good idea to get together with other packeteers to perform this operation. Designate one station as the receiver and have its operator turn on monitoring (MONITOR ON). Perform this sequence of tests off the air (use a dummy load) or on an unused frequency since no one else can use the frequency while you are testing. The process:

1. Open the squelch on the receiver so that the TNC is receiving unsquelched noise.
2. At the transmitter set TXDELAY to some low value, say 10 ms (for most TNCs the value for this is 1).
3. Enter a beacon text and enable beacon every three seconds with the following commands: BTEXT TESTING BEACON EVERY 3. At this point the transmitter should key every three seconds and you should hear "packet racket" at the receiver. You may or may not see packets displayed on the screen at the receiver.
4. Enter higher and higher numbers for TXDELAY until the receiver begins displaying the beacon packets. The value of TXDELAY is the amount of time it takes the transmitter to switch from receive to transmit and begin sending valid data. Remember this value as the transmitter switching time.
5. Now close the squelch on the receiver (no noise between packets). The receiver should stop displaying the beacon packets.
6. Continue to increase the value of TXDELAY at the transmitter until the receiver again begins displaying the beacon packets. The difference between the previously determined transmitter switching time and the current TXDELAY is the receiver's squelch opening time. If this turns out to be a very long time, i.e. longer than about 100 ms, I suggest you get a different receiver. For example, my ICOM IC-245 has a squelch opening time of 50 ms.
7. Perform the above sequence of tests for every receiver and transmitter.
8. Set TXDELAY for each transmitter by taking the transmitter keyup delay (calculated in step 4) and adding it to the longest squelch opening time of all the receivers tested.
9. Turn off beaconing at the transmitters (BEACON EVERY 0).

Some receiver/TNC combinations work properly with the squelch left open on the receiver. If the carrier detect light on the front of the TNC does NOT come on with receiver noise (squelch open) but does come on when receiving packets, leave the squelch open at all times. If the carrier detect light is on with noise you have no choice but to close the squelch.

Cutting Down on Collisions

Now is the time to set the parameters that control channel sharing. Check the manual and determine whether or not your TNC has the commands PERSIST and SLOTTIME. The presence of these commands indicates that your TNC supports the more advanced channel sharing technique called P-persistent CSMA (Carrier-Sensed Multiple Access). P-persistent CSMA helps to prevent several stations from trying to transmit at the same time if they all have data to send at the same time.

You may have an older TNC that doesn't support the SLOTTIME and PERSIST commands. In that case you need to use the DWAIT parameter. The original purpose of the DWAIT parameter was to prevent a station from colliding with or "stepping on" a digipeater as it retransmits packets. When the channel is clear, i.e. when no one else is transmitting, and your TNC has data to transmit, your TNC waits for the length of time specified by DWAIT before keying the transmitter. This fixed waiting period is a drawback because two or more stations that have data to send wait patiently for the period specified by DWAIT and then transmit at the same time, guaranteeing a collision. The TNCs that support P-persistent CSMA vary this time based on the SLOTTIME and PERSIST commands so that there is much less likelihood of a collision.

If your TNC does not support P-persistent CSMA, then set the value of DWAIT to be about twice the largest TXDELAY value for all the stations in your local area. This gives those stations with P-persistent CSMA a reasonable chance to get a transmission in ahead of a station that does not have P-persistent CSMA. Don't worry: The P-persistent CSMA stations sometimes wait longer periods so they will often let the other stations transmit first.

If your TNC supports P-persistent CSMA (which it does if it has the PERSIST and SLOTTIME commands) then first enter the following command: DWAIT 0. This disables DWAIT and allows the persistence feature of the TNC to control channel access.

Next, set the value for SLOTTIME equal to the largest TXDELAY value for all of the packet stations in your area (all stations in a given local area should have the same value for SLOTTIME). For instance, if the largest TXDELAY is 26 (260 ms) set SLOTTIME also to 26.

The value of PERSIST is a function of the number of other stations also using the frequency. The formula is: P = 255 x (1/n), where "P" is the value to be entered to the PERSIST command and "n" is the number of other stations (beside yourself) using the channel. For example, if you are having a QSO and there are four other stations that have QSOs of their own, then there are a total of five stations besides yourself on the frequency. Using the formula above you calculate P to be: 255 x (1/5), or 51. In this case you enter the command: PERSIST 51. If you do not want to spend time calculating the best value for PERSIST a good guess is to set it to 64. This keeps your station from being a bad neighbor most of the time, although it slows things down somewhat when your QSO is the only one on the channel.

Frame Acknowledgment (FRACK)

The last parameter to set is the frame acknowledgment timer (FRACK). This is the amount of time the TNC waits for an acknowledgment after transmitting a packet before it assumes that the packet was lost. Most TNCs set the FRACK value too low and a problem occurs when the channel is busy. The receiver may receive the packet without any problem but, due to channel activity, may not be able to send an acknowledgment within the time allotted by the sender. In these cases the sender must resend the packet.

The solution to this problem is to increase the value of FRACK. Start out with 10 seconds, set with the command: FRACK 10. With a lot of channel activity, set FRACK to 15 or even 20 seconds. (Some TNCs won't accept a value higher than 15 seconds.)

Operating

At this point your station is set up and ready for operation. To connect to another station, for instance WB6RQN, type and enter the command: CONNECT WB6RQN and wait for the "CONNECTED" message. If the other station is too far away to reach directly you may need to use an intermediate digipeater. To

connect to WB6RQN via the W3ABC digipeater the command is: CONNECT WB6RQN VIA W3ABC. To add a second digipeater, e.g. W4XYZ, to the string the command is: CONNECT WB6RQN VIA W3ABC, W4XYZ. You are allowed up to eight digipeaters between you and the destination. It's unlikely, though, that you could maintain reliable communication with more than two digipeaters between you and the destination, unless the links are unusually strong and channel activity very light.

Many people discover that their TNC offers a mode that automatically transmits a beacon packet (remember we used that feature to calculate the TXDELAY value). At first thought, this appears to be a good way to tell others that you are on the air and looking for a QSO. On the other hand, imagine what things would be like if everybody transmitted a beacon. So much channel capacity would be used to send beacons that precious little would be left to send data. This is, in fact, what happens, to the ire of everyone. No, beaconing is a bad idea. Avoid it like the plague!

To make a QSO it's much better technique to listen first and then pick a station to try to contact. To ease this process most TNCs offer the MHEARD command. When you enter the MHEARD command, the TNC displays the callsigns of the most recently heard stations. Use this as a guide to the other stations currently on the air.

There is much more to learn about Bulletin Boards and Network Nodes but that is beyond the scope of this article, and is amply discussed in other articles in this Special Packet issue. Following the procedures outlined here lets you extract the maximum performance from your station so that you can spend your time operating, learning about, and enjoying the fascinating hobby of packet radio. 73 and happy packeting!

Brian Lloyd WB6RQN has pursued amateur radio enthusiastically since age eight. He recently co-founded Sirius Systems, a networking business in Petersburg, Virginia. You may reach Brian at: 5712 Stillwell Rd., Rockville MD 20851.

Number 7 on your Feedback card

73 Review *by Brian Lloyd WB6RQN*

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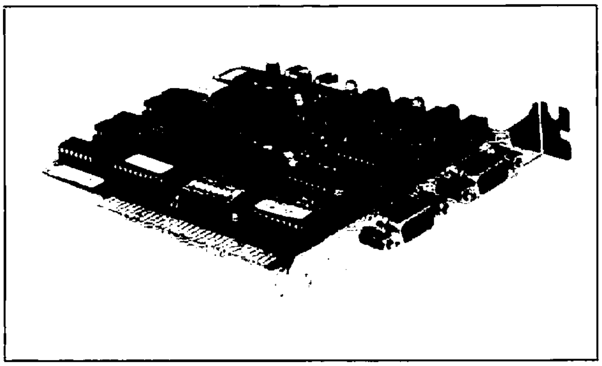
Tel: (800) 999-0204.
Price Class: $140–170, (three models)

Do you have an IBM-PC/XT/AT computer and operate packet radio? If so, you will want to take a serious look at the DRSI PC*Packet Adaptor (PCPA). This board plugs into your IBM or compatible and turns it into a complete packet radio communications system. With the PCPA, you no longer need a TNC; the PC*Packet Adaptor has all the functions of a TNC, and then some. The software that comes with the board lets you operate it as a TNC, a bulletin board, a Net/ROM node, and a TCP/IP network host. This product is one of the most significant to appear on the packet scene.


*The DRSI PC*Packet adaptor interface board.*

Product Description

The PCPA arrived in the mail. Inside the surprisingly small box was a user's manual, a hardware manual, a get-started-right-now sheet, four 5¼" diskettes, and the PCPA itself. All the material appears to be of high quality, and the board has sockets for all chips so that repairs should be easy if a problem occurs.

The PCPA board uses the standard half-card format for the PC. You can plug it into any slot in any PC/XT/AT compatible computer system. The board is available in three versions, depending on the type of interface desired. The type one board supports one 1200 bps Bell 202 modem (for VHF packet) on-board, and one RS-232 port for interfacing an external modem. The type two board (the version reviewed) has two built-in 1200 bps modems. The type three board has two RS-232 ports and no on-board modem.

If you plan to experiment with modems or to operate on HF, you will probably want the type one or type three board. If, however, you want to operate on multiple VHF frequencies, the type two board is a better choice. If you are unsure, get the type one board. You can always attach a Bell 202 modem to the RS-232 port for dual VHF operation.

The on-board modem I used, the TCM3105 from Texas Instruments, is a single 16-pin DIP occupying little space on the board. Along the top edge of the board are the modem's PTT and carrier detect status LEDs. Each modem also has a watchdog timer to prevent a hardware or software error from keeping your rig key-down forever. Additionally, the modem's transmit and receive signal level controls provide compatibility with just about any radio configuration.

The PCPA has a feature that I have not seen in any other board for the PC; you can run up to four PCPA boards in the same PC, and all the boards can share the same IRQ line. Imagine having eight packet radio channels connected to your PC!

Installing the Board

Type two, the board I reviewed, has two radio ports. I constructed cables to attach it to my 2m and 70cm rigs, without any major problems. Radio hookup was straightforward—as easy as hooking up any TNC. Since the board is inside the PC, there is no TNC-to-computer connecting cable or the hassle that goes along with it.

Before installing the board, you must select the interrupt request line (IRQ) and the I/O address so no conflicts with other devices in the computer will arise. The boards come configured for IRQ-7 and I/O address 300H. Unless you have many strange devices in your computer, the default values will probably work just fine.

If you are using a local area network or have two printers connected to your computer, you may have conflicts between these and the PCPA, requiring you to change the IRQ line, the I/O address, or both. If you need to change the IRQ line, you can select IRQ-2 through IRQ-7. If you need to change the I/O address, you can select 300H or 310H. The documentation is quite clear on how to detect and avoid these problems.

After you have installed the board, do not replace the PC's cover at once. You will need to get at the board to calibrate and set the signal levels.

Software

One of the strengths of the PCPA is that it comes with so much software—the basic PC/TNC package; the "BB" bulletin board package by AA4RE; PC/Node; NET/ROM; BBS package by G8BPQ, and the KA9Q TCP/IP "Net" package. You must decide what your objectives are so you can choose which software packages to install. Since I had enough room on the disk, I chose to install everything the four disks offered.

The PC/TNC package is installed first. It contains the driver for the board, the TNC emulator, and the calibration software. The board and system are ready to use, unless you have a conflict with one of the other boards in your system and have changed the switch settings. Then you will need to run the INSTALL command. This makes the necessary changes to the software packages so they will recognize your board when it has been reconfigured.

After installing the basic software, you can run the calibration program. It is a good test to see if the board is working. If anything strange happens, you can bet that there is a conflict between the PCPA and one of the other boards in your PC. I did run into a conflict, and it showed up during calibration. I removed the conflicting board temporarily, and calibration proceeded without a hitch. Then I changed the switch settings on the PCPA to eliminate the conflict.

Changing the switch settings required running the INSTALL program provided with the PCPA. This process is clearly defined in the documentation so there was no problem.

The next step was to run the background TNC program. This program is a terminate-and-stay resident (TSR) program that runs on the PC in the background and provides all the features of a TNC. There are two flavors of this

program: TNCTSR-S and TNCTSR-L. The latter is larger. Although TNCTSR-L has more buffers so you can store more messages and data when operating unattended, I found that TNCTSR-S had more than enough buffer capacity for my use.

To interact with other users, DRSI provides two TNC communication programs: TNCTERM and THS (The Hostmode Server). TNCTERM looks and operates like a dumb terminal connected to a TNC running the WA8DED code. This is what I run in my old TNC-1, so I was immediately at home with this software. The problem with TNCTERM is that it is not very "pretty;" it has no windows or special buffers for brag tapes, for example. It is just a plain old TNC interface.

THS, written by Peter Heinrich HB9CVV, is a much fancier program, and I suspect that most people will want to run it as their terminal program. THS supports several windows for multiple sessions, a window for commands, a number of different buffers for capturing or sending information, and a file transfer mechanism called YAPP (Yet Another Packet Protocol). THS is about the nicest AX.25 packet program I have used. I especially like the multiple receive windows for keeping sessions separate, as I sometimes run two or more QSOs at the same time. The full documentation for THS is on the disk.

Bulletin Board Operation

BB, the second software package, is a very nice multi-connect bulletin board program written by Roy Engehausen AA4RE. This is the best bulletin board program I have used. The documentation is a little sketchy, but I found that I had no problems *if* I very carefully followed the procedures outlined in the documentation (contained In several files on the disk).

BB is a full WØRLI/WA7MBL compatible BBS program with a very nice additional feature: It is multi-connect and multi-user. With BB running, several people can be connected to the BBS at the same time. Where I live, you can wait quite some time in the evening for a chance to log into the BBS to check your mail. BB even supports mail forwarding while users are on the BBS reading or sending mail.

BB takes advantage of the background service provided by TNCTSR. If you are using BB, there is no need to run the big version of TNCTSR. BB runs in the foreground and pretty much takes over the PC, but I suspect that is neither unexpected nor a problem for anyone who already runs a BBS.

I configured BB for one port and had my mail forwarded from the local BBS just so that I could see it in action. I also logged into and used BB from one of my portable packet stations. I had the BBS up and running in about 15 minutes. It performed flawlessly for the couple of days that I had it up. (Some people in the area even logged in and used the BBS.)

As a result, I would not hesitate to recommend BB to anyone planning to set up a BBS. In fact, building a BBS around the PCPA and BB is probably the most cost effective way to get a BBS on the air. Not bad when the best performance also comes at the best price.

PC/Node

NET/ROM by Software 2000 has become a very popular tool for connecting different areas of the world together into a packet radio network. The problem with NET/ROM and its clone TheNet (from Nord> <Link) is that they are ROMs that plug into a TNC. A TNC does not make a very good network node, and you need a separate TNC for each radio you want to connect. If you consider the cost for a two-port NET/ROM node and include power supply, two TNCs, and two NET/ROMs, you will spend the better part of $500. For that price, you can get a PC, the PCPA, and this software. When it comes time to expand to more ports, PC/Node and an additional PCPA are much more cost effective.

Unfortunately, I did not get a chance to try out PC/Node. I did read the documentation that came on the disk, however. Installation and configuration appeared to be quite clear and straightforward.

TCP/IP

The last software package that DRSI provides with the PCPA is a version of Phil Karn's Net program. Net is a complete implementation of the industry standard networking protocol TCP/IP, as well as a full AX.25 and NET/ROM implementation. (There is even a WØRLI/WA7MBL compatible BBS available to work with Net, but it was not available with the DRSI version at the time I tested the PCPA.)

Net is more complex to operate than THS, but it provides much more flexibility. You can make connections via AX.25, NET/ROM, and TCP/IP. The number of connections you can have concurrently are limitless. You can also do multiple file uploads or downloads. Imagine receiving and recording your mail from more than one BBS at the same time.

The NET/ROM capability is nice to have. Other NET/ROMs think that your station Is another NET/ROM and can use your station to forward NET/ROM packets. With the PCPA, you can have several ports to provide cross-band and backbone linking. In terms of price, it is less expensive to construct a four-port NET/ROM Meganode using a PC and two PCPAs than it is to use four TNCs and four NET/ROMs. It also eliminates the need for the octopus cable to connect the TNCs together.

Net really shines in running the Internet Protocol Suite (TCP/IP). Many protocols make up this suite, but a few are worth mentioning here. The first is Telnet, a terminal-to-host protocol. Telnet is an official protocol specification for connecting a terminal to a host computer. In amateur radio, Telnet is used to carry on a keyboard-to-keyboard QSO.

The second protocol is the File Transfer Protocol (FTP). FTP provides both binary and ASCII file transfers. The ASCII mode performs all character translations necessary for file compatibility with the destination host computer. Best of all, it is very efficient—a big win over programs like YAPP and BtoA.

The third protocol, the Simple Mail Transfer Protocol (SMTP), is an industry standard electronic mail protocol (the WØRLI BBS supports SMTP messages, if I am not mistaken). Since it is a standard, it is compatible with mail sent by other non-ham computer systems.

Net supports other connection modes besides packet radio. It can use inexpensive local area network cards to interconnect multiple computers. Net also supports RS-232 connections for point-to-point or autodial connections.

I have used Net to connect all the computers in my shack (only one of which is an MS-DOS computer). That way, I could access my computers from anywhere. I take my laptop computer with me and use TCP/IP to send mail, transfer files, or even run programs on the computers back home. Some of the connections use Ethernet and some use RS-232. The only difference is speed, which you can't even detect in most cases.

The RS-232 connection makes another mode of packet operation possible: the "wormhole." Sometimes it is impossible to provide an RF link to connect two stations. In such a case, you can substitute a telephone link to keep information flowing while the RF links are established or repaired.

Since many companies, educational institutions, and governmental agencies use TCP/IP to connect their computer systems, it may be possible to use excess network capacity to give your packets a free ride. In one experiment, several hams using Net built a connection between a shack and a remote host computer using five RF connections and about seven landline and LAN connections. Seven computer networks were involved. It was amazing to see packets moving quickly and reliably between the ham's PC and the remote mainframe hundreds of miles away.

The Future

Lots of new software is becoming available for the PCPA because it is so easy to develop software on the PC. No ROMs, ROM burners, cross compilers, or special development systems are required. This means that, unlike TNCs, there will be more and more software for the PCPA as time goes on. This translates Into long life for the PCPA. What capability you have today is only a fraction of what you will have tomorrow. Already the PCPA has been used to perform packet communications at 56 Kbps using the WA4DSY modem. At those speeds, it could even be used for packet voice operation.

Conclusion

The PC*Packet Adaptor is an excellent product; it is reliable and appears to be well-built. The software is nothing short of phenomenal. Would I recommend it? You bet—without any reservations at all. This is what packet radio was meant to be: powerful, fast, efficient, and expandable. The PC*Packet Adaptor makes it worthwhile to get a PC just for packet radio operation. 73

Brian Lloyd WB6RQN has pursued amateur radio enthusiastically since age eight. He recently co-founded Sirius Systems, a networking business in Petersburg, Virginia. You may reach Brian at: 5712 Stillwell Rd., Rockville MD 20851.

My SX-64 Runs Digicom!

Low-cost packet solution for your portable C-64.

by Ted Drude KA9ELV

By now, most packet radio enthusiasts are probably aware of the excellent public domain software TNC-2 emulator called Digicom>64, which runs on Commodore C-64 computers. It was originally written by West German hams Stefan Eckart DL2MDL and Florian Radleherr DL8MBT. (See Barry Kutner W2UP's article on Digicom in the August 1988 issue of *73*.)

Digicom is a great way of getting on packet radio, assuming you have a C-64 computer or a compatible system (C-64C, C-128, or C-128D). You can use several types of inexpensive single chip modems with Digicom. Most can be built from scratch or from a kit for under $50. Version 2.0 of the program has many features not even found in hardware TNC-2s, including multi-connects, auto message store and forward, large text buffers, and many BBS-like functions.

While C-64 users have been having a ball with Digicom, Commodore SX-64 owners have been left out in the cold. That is, until now! If you couldn't figure out how to get Digicom running on your SX-64 portable, you can get the complete story here, including how to modify Digicom modems to work with the SX-64, and how to make the proper internal connections.

What Is An SX-64, Anyway?

The SX-64, a portable version of the C-64, operates on AC power. It consists of a C-64 compatible CPU, a 1541 disk drive, a five inch color monitor, and a built-in audio amp and speaker. All components are housed in a 15″ x 16″ x 5″ metal case with a sturdy carrying handle. The detachable keyboard folds up over the screen and disk drive for easy transportation.

The design of the SX-64, with its ample internal power supply and its huge cast-aluminum heat sink, makes it more durable than the C-64. And, unlike most C-64s, you can leave the SX-64 on for days, usually without the worry of overheating or other problems.

Commodore originally sold the SX-64 for $995. When price wars drove the home computer market soft in 1983–1984, these machines were discontinued, and many were sold through surplus and liquidation channels. However, SX-64 repair parts are still available, and many SX-64s in good to excellent condition are currently available at hamfests and computer flea markets for $300–$500.

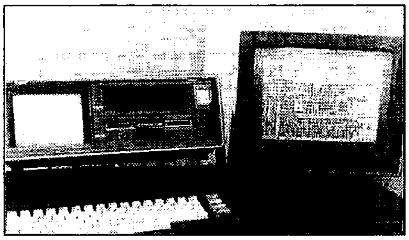


Photo A. This SX-64 (left) is running Digicom>64 Version 2.10 with an internally mounted packet modem. External video monitor (right) displays incoming packets, with Digicom in monitor mode.

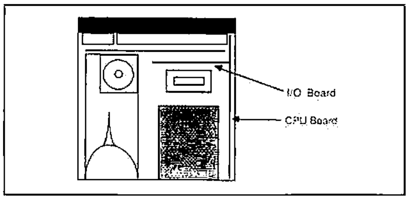


Figure 1. Commodore SX-64 (top view).

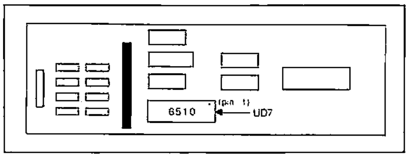


Figure 2. SX-64 CPU Board (component side).

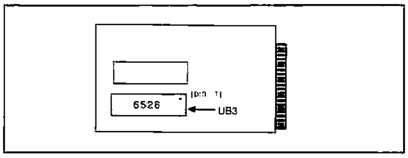


Figure 3. SX-64 I/O Board (component side).

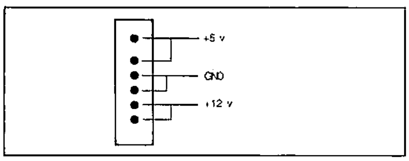


Figure 4. SX-64 CPU Board power connector (detail).

Why Won't Digicom Run on the SX-64?

The SX-64 is virtually 100% software compatible with the C-64, but the hardware is a different story. Digicom is written to address a modem circuit connected to the C-64's cassette port. That's fine for C-64Cs, C-128s, or even C-128Ds, all of which have the nearly obsolete cassette port installed on them. But Commodore, in its infinite wisdom, decided to put all C-64 I/O ports except for the "redundant" cassette port on the SX-64's back panel. Almost all the internal circuitry needed for the cassette port, however, it is still present inside the SX-64; it just isn't brought out to an external port.

Get the Latest Release

Digicom version 1.42 was originally written to overcome the missing cassette port problem since it addressed a modem connected to the user port, which is present on the SX-64. However, this version of Digicom is much less powerful than versions 2.0 and later, as it lacks multi-connects, connect logging, store and forward, and so on. The actual release copies of version 1.42 are buggy and poorly documented.

I suggest you use the latest version (version 2.10 as of this writing). Besides, many SX-64 owners already use the user ports for other things, such as telephone modems, RS-232 ports, or, as I am doing, for home-brew Centronics printer interfaces. The secret is in knowing how to make the right connections between a Digicom modem and the SX-64's internal chips.

Installing the Modem

Begin by removing the ribbed plastic trim panels on both sides of the computer. They're held in place by four small screws, two on each side, in the middle of the back heat sink panel. After removing the screws, slide the panels out toward the rear of the computer.

Next, remove the six countersunk machine screws, three on each side, that are holding the top cover in place. After that, remove the two large screws at the top corners of the back

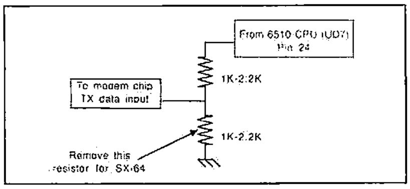


Figure 5. Digicom modem modification for SX-64.

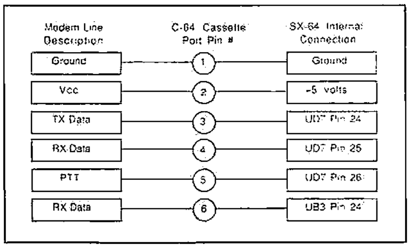


Figure 6. Digicom modem to SX-64 wiring diagram.

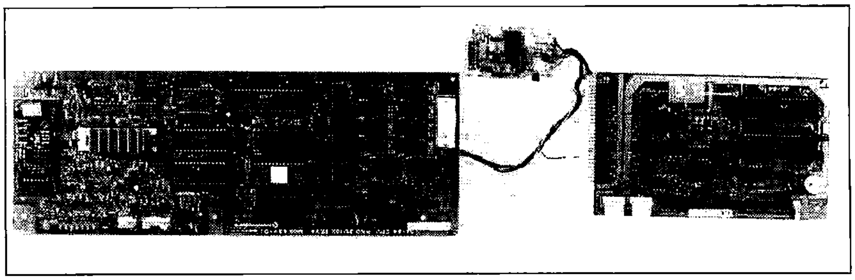


Photo B. You can safely solder the leads from the Digicom modem (top) to the solder side of the SX-64's CPU board (left) and I/O board (right), using a low wattage, grounded iron. Work patiently, use solder sparingly, and avoid bridges.

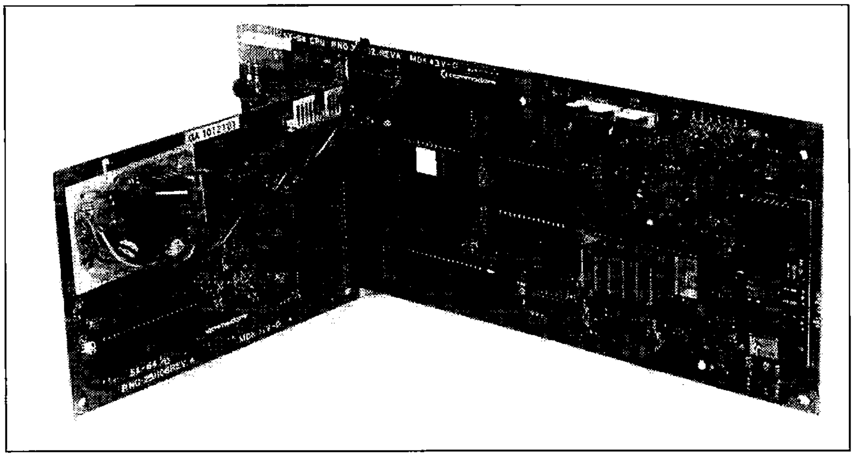


Photo C. Here's the modified N4PLK modem mounted to the SX-64's CPU and I/O boards via a circuit board standoff (upper left corner of I/O board). Connections from modem to transceiver are made by using the external serial port pin socket, cable, and DIN connector.

heat sink panel and (carefully) loosen the two lower screws. This should let you remove the top cover of the SX-64.

Looking down from the top of the open SX-64 (see Figure 1), you can identify the major components of the system. You'll have to remove the CPU and I/O circuit boards, which are located on the right and connected in an inverted L shape. Before you can do this, you have to remove numerous cable connectors that hold the boards in place. Remove the boards as a unit; don't try to separate them inside the case. (A word to the wise: Mark the cable connectors to make sure you reconnect them correctly.)

Identifying the Proper Connections

With the CPU and I/O boards out, you'll want to identify the chips that connect to the Digicom modem. On the CPU board (see Figure 2), find the 6510 microprocessor chip. It's identified as UD7 on the board's silk-screened legend. Connect wires to pins 24, 25, and 26 of this chip.

Now see Figure 3. On the I/O board, find UB3, a 6526 CIA chip. It's the lower of the two 6526s on the I/O board. Connect a wire to pin 24. To find the correct pins on either of these chips, it's faster to start counting from pin 21, the pin diagonally across from pin 1.

If you're mounting the Digicom modem internally, you need to connect to the internal power supply. Fortunately, the SX-64 has enough surplus current to power most modems. The CPU board's power connector is a good place to get regulated voltage. This keyed 6-pin connector is at the lower left side of the CPU board (refer to Figure 2). Both +5 and +12 volts are available, as well as ground (see Figure 4).

Modifying the Digicom Modem

W2UP's article (mentioned earlier) presented a modem circuit capable of both HF and VHF packet operation using the AMD 7910 chip. Craig Rader N4PLK offered a simpler, more compact VHF-only modem using the TCM 3105 chip (see the February 1989 issue of *73*). Other modem circuits, that have appeared in various forms, use the XR-2206/2211 chips. I chose the N4PLK modem for my project because of its small size and single supply source voltage.

While all these modems work with the SX-64, they need a slight modification because the cassette motor supply voltage on the C-64 cassette port, line number 3, isn't at TTL voltage levels. The cassette motor supply voltage, controlled by a bit on the 6510 I/O port, is switched through a transistor network to handle the current. The actual output level varies from 0 to 9 volts, depending on current loads.

Typically, a Digicom modem uses two 1–2.2k resistors in series to act as a voltage divider for line 3 (see Figure 5). This brings the high voltage down to 3–4.5 volts, which is within TTL levels. To modify a Digicom modem for an SX-64, simply remove the resistor going to ground. The voltage divider network then becomes a single series resistor, which you can keep intact if the input line is directly driving a transistor. On the N4PLK modem, line 3 goes to a TTL level input, so I replaced the series resistor with a wire jumper, because the 6510 I/O port lines are rated to drive only a single TTL level load.

Making the Right Connections

When you're ready to connect the modem to the SX-64, follow the wiring diagram in Figure 6. This gives the description of the internal modem line, the equivalent C-64 cassette port line number, and where the line should connect inside the SX-64. I removed the 6-position female edge connector (normally used with the C-64 cassette port) from my modem, and ran jumper wires directly from the modem to the SX-64 circuit boards.

I tried a variety of methods for tapping into the SX-64's circuit boards, including micro-clips and DIP sockets. The best method appears to be soldering directly to the solder side of the boards, using a low power, grounded solder iron (see Photo B). Work slowly, go sparingly on the solder, keep some desoldering braid handy, and watch out for solder bridges.

Take note of one important connection not shown on the wiring diagram. Pin 24 of UB3 also goes to pin 1 of the serial bus of the SX-64. For some reason, many C-64s must have pin 1 of the Serial Bus disconnected for Digicom to work properly. Some hardware interrupt conflicts appear to cause this problem with certain serial bus devices (especially older disk drives, and printer interfaces). In any case, if you run into this problem, try disconnecting the black jumper wire from P11 to P13 on the I/O board. You can safely

remove it without affecting any serial bus operations.

Mounting the Modem and Tidying Up

Before you connect the modem permanently, consider how you plan to mount it. I kept the modem completely internal and mounted it on the I/O board, using a circuit board standoff and insulator available from Radio Shack (see Photo C). With the modem internally mounted and powered, you have to find a way to run the four external lines to your transceiver (AUDIO IN, MIC OUT, PTT, and GROUND). You may decide to run a cable out of the cartridge expansion port, on top of the machine, or use a thin ribbon cable and run it between the side panels.

> ***"While C-64 users have been having a ball with Digicom, Commodore SX-64 owners have been left out in the cold . . . until now!"***

I wanted a cleaner approach, however, without having to drill any holes in either the SX-64's case or its back panel, so I decided to use the external serial bus connector. (I didn't choose the external VIDEO port because I like to run a larger monitor on my SX-64 when I'm not operating portable.) By disconnecting the internal header connector from the I/O board and hooking the first four positions of it to the pin connector on my modem, I have a clean output port for my Digicom modem. The 6-pin DIN serial bus connector on the back panel now mates directly with a shielded cable running to my transceiver.

Kudos

Special thanks to Mike Hooper KF6FU and Dan West K6DFM for their detailed information about Digicom and confirmation that it could run on an SX-64, to Jeff WA6FWI for the details on internal modem connections, to Craig Rader N4SCY for help on modifying the Digicom modem for the SX-64, and to Robert "Ozzie" Osband N4SCY for all the encouragement and moral support, as well as extensive testing of the completed system. ■

Ted Drude KA9ELV has been a ham for 10 years, and especially enjoys packet and 10m FM. Ted is the Associate Editor of Computer Shopper *magazine. Other interests include photography and computer games. You can reach Ted at: 6170 Quito Ave., Cocoa FL 32927.*

Digital Dreams

We have not yet begun to packet!

by Bdale Garbee N3EUA

DXers: Imagine a new operating mode that would let you work that last country for DXCC a little more easily, and with fantastic audio quality! What about a nationwide database to help you spot that elusive new country, in real time? Or a database with QSL information at your fingertips?

ATVers: Imagine a national network of amateur High Definition TV (HDTV)—with image resolutions at least twice that of your broadcast TV images—with nearly perfect image transmission between any two places of your choice.

Repeater trustees: Imagine a nationwide repeater linking system, with audio quality as good or better than what your local users are already accustomed to? How about if the snazziest repeater controller you've ever seen was included for free?

Members of public service or emergency communications groups: Imagine how the people you serve would feel about being able to exchange 1000 times as much traffic throughout your state as is presently done, and with less effort.

Computerniks: Imagine having enough space for all the neat applications you'd like to try out. Would you be interested in loading programs from a remote file server located across town, across the state, or even in another country. . .and running them just as if they were on your very own hard disk, and just as quickly?

Special interest folks: Imagine sharing your interest(s) with others around the nation in an ongoing bulletin board forum just like those used on ARPANET, Compuserve, and other networks and online services.

Packeteers: You probably think that you already know what I'm leading up to. But, even as a packeteer, you may not realize the potential of digital communications, using technologies *already available.* All of the above "fantasies" are just a few of the neat things you could do if only you could move enough bits per second through a real packet network. The fact is, you *can*, and this article explains how!

Move Up Frequency

Look upward for the answer. Two meters, where most 1200 baud operation is today, is way too restrictive. There are several very simple reasons for that: 2 meters has become very crowded, and, most important of all, it does not allow us the signal bandwidths needed to run truly high-speed packet. (Recall that the higher the data rate, the wider the minimum bandwidth must be.) The ham microwave bands, however, are still virtually deserted, and there are no signal bandwidth restrictions: You can have a signal many megahertz wide there if you want to! And yet to run packet at the truly awesome rate of 1 Megabaud—*700-800 times* the rate of the standard 1200 baud packet today—requires a signal bandwidth that could easily fit into many of the ham microwave bands.

> ***"Whether your interest is DX, rag-chewing, mobile, repeaters, or CW, a nationwide network supporting a variety of applications can make ham radio even more fun for you."***

For higher speed operation, these bands actually work better than VHF or UHF because small, highly directional antennas can allow our transmitted power to go much more where we want it to, wasting less of it in the wrong direction. Combined with the larger widths of the amateur microwave bands, this advantage allows efficient and affordable high-speed radio links.

One of the lessons to be learned from the recent loss of part of the 220 MHz band is that the FCC may be increasingly concerned with the level of use in various portions of the amateur radio spectrum. If there are bands that we aren't using fully that commercial interests want, we'll have a hard time rationalizing to the FCC why we should be allowed to keep spectrums we're not using. The answer is simple, and without pain. . . find ways to better use these bands!

You may regard the world above a gigahertz with some fear and suspicion. In reality, though, emerging microwave surplus and technology is quickly making it nearly as easy and cheap to build packet hardware for 1.2 GHz or 10 GHz as it is for 144 MHz. Several projects are underway right now that are opening the door to much higher speeds on bands at VHF and above. There is a standardized 9600 baud radio modem now available—a good "next step" for many packet users. Hams in different parts of the country are using 56 kilobaud modems with conventional VHF/UHF transverters, with a good deal of success, on bands as far down as 1.25 meters! Prototypes are being developed for dedicated "digital radios" for the 900 MHz and 1.2 GHz amateur bands that can provide 250 Kbps for a parts cost of under $200 per system. Dayton this year gave us demonstrations of dedicated digital radios for the 10 GHz band, using surplus radar gun modules to achieve between 1 and 10 Mbits/sec, for *under $100* per system! This sort of equipment, which is here **now**, can be put to use in providing high speed user-to-user and interregional digital communications.

Building a Network

We need to be able to efficiently direct packets from one user to another, with minimum hassle. Up to now, the technology amateurs used for building packet networks consisted mostly of TAPR TNC-2s and clones running replacement firmware to provide network functionality. While this was an adequate way to build 1200 baud networks, the Z80 microprocessor used in the TNC forced limitations in speed and software capacity that prevented us from building high speed networks. This is not surprising, since these are Terminal Node Controllers. They were never intended to be network packet switches! To build a fast network we need to look for higher performance solutions.

Luckily, for about the price of a dual-ported configuration (that is, two TNC-2s, and two copies of some networking firmware) we will soon be able to buy a PS-186 packet switch board from AEA that is based on an 80C186 and which has 4 high-speed radio ports. Or, we could use the the K3MC card that will be available soon. This card is based on a NEC V40 (software compatible with the Intel processors) and has two or more medi-

um-to-high-speed ports. Either of these boards is capable of switching multiple high speed channels, and can provide far more memory addressing capacity than Z80-based TNCs.

Challenges Remain

Having faster and more capable packet switching hardware, however, doesn't solve all of our problems. We'll need to work together to solve specific local propagation problems for the hardware to work well, and we will need to agree upon and coordinate data routing at the "software" level so that the packets go quickly and directly to their destinations. These are, however, very manageable problems.

One of the most important difficulties with existing 1200-baud packet networks is the large number of single-port network nodes, either simple digipeaters, or NET/ROM or ROSE nodes (two versions of a network system). When the network must contend with local users for access to the RF channel, the efficiency of a network can easily drop to near zero! The way around this? Install a "backbone" channel—a high data rate channel (e.g. 4800 or 9600 baud) that only the nodes of a packet system use, to automatically route packets between each other. An end user—one who connects into the network—would not have direct access to the backbone. The highly successful TexNet packet network, for example uses 9600 baud backbone channels. We **MUST** further pursue the installation of networking hardware with one or more channels dedicated entirely to "backbone" functionality, the communication between packet switches. Local users can then use separate channels for access, at whatever speeds and using whatever frequencies and modulation techniques are appropriate in each area.

A simple technique for making a dramatic improvement in local packet throughput is to make one or more of the local access channels full duplex—that is, having two channels in full-time operation so that the participating packet stations can transmit and receive simultaneously. This is exactly the same idea as using a repeater for voice. Everyone can hear everyone else, so the chance of two people transmitting at the same time and causing a collision goes way down. And it's no harder to build a full duplex digital repeater than it is to build a voice repeater! Full duplex access channels are already in use in several packet networks around the country.

Software

Having faster modems and radios, however, isn't enough. Once we've begun to build a real network of high-performance packet switches linked with fast microwave links, we will be ready to start experimenting with a wide array of new applications. The importance of having a solid software foundation, using proven networking concepts to provide a consistent and simple interface for writing new applications, will become more apparent.

Fortunately, we're well on our way to

developing the kind of software that can exploit these data rates. There's already a host of networking systems which are being improved by the day (the five most popular systems are featured elsewhere in this issue). Today, among other features, software provides electronic mail, remote log-in and keyboard-to-keyboard QSO functionality, file transfer (including binary files), and the ability to obtain information about users in other areas. There's no limit to the applications that can be added.

Immense Potential

So, what's the bottom line? TNCs and 1200 baud modems and keyboard-to-keyboard QSOs are not the sum and substance of "packet radio." Recognize that what we've done so far in the name of packet radio is but the first small step towards what we are capable of doing. A real digital network won't take away from the present interesting areas of amateur radio...it will add to them! Whether your interest is DX, rag-chewing, mobile, repeaters, or CW, a high data rate nationwide packet network supporting a variety of applications can make ham radio even more fun for you.

> *". . . we should recognize that what we've done so far in the name of packet radio is but the first small step toward what we are capable of doing."*

As mentioned above, very inexpensive links on 900 MHz, 1.2 GHz, and 10 GHz, with speeds from 250 kbps to 2 Mbps, have been tested on real paths in Colorado and in Silicon Valley. We will be seeing the first offerings in a new round of packet digital hardware with dramatically higher performance than the TNCs of yesteryear. We will actually have the tools in hand to put a whole new wave of applications on the air. But while we're busy implementing this next wave of packet radio, let us not forget to dream. The young but growing amateur radio digital network needs **YOUR** dreams and help. We've only just begun! 73

Bdale Garbee N3EUA has long been involved in digital networking, but finally became a ham in 1985 when he came across his first TNC. This began his intense affair with packet radio, which has led him to many achievements, including becoming the system integrater for packet radio's most sophisticated and versatile networking package, TCP/IP, and becoming the Vice-President of the Tucson Amateur Packet Radio (TAPR) group. Bdale currently writes oscilloscope firmware for Hewlett-Packard. Other interests include cooking and reading science fiction. You may contact him at 4390 Darr Circle, Colorado Springs, CO 80908.

Let the TNC Work While Your PC Sleeps

Give your older TNC personal mailbox capability—with no hardware changes!

by David Bartholomew WB6WKB

Many packeteers are using the older TAPR TNC-2 units, or their clones, manufactured by AEA, MFJ, and others. Unlike some of the newer models from Kantronics and Heath, these TNCs do not provide an automated "personal mailbox" feature to accept incoming messages.

However, there's a procedure that does this very well, and I've used it on the AEA PK-80, the PK-232, and the MFJ-1270 TNCs. It will likely work with other models. This procedure isn't in any TNC manuals I've seen.

Turn Your Packet Answering Machine On

First, turn off all the monitors with MON OFF and MCON OFF. (On the PK-232, use MON 0 and MCON 0.) Set up your CTEXT to say whatever you want. I usually say something like, "Dave's not in, please leave a message here or at WB6YMH-2...73." Make sure CMSG is ON. Also, if it's not already set on your TNC, set DAYTIME, then CONSTAMP ON and DAYSTAMP ON, too. This will let you know when people contacted you.

Now type in DAY, press Ctrl-S, and type ENTER. This "suspends" the TNC's output. Now disconnect the RS-232 cable from your computer or terminal, and turn it off, but leave the TNC and radio on. This allows you to use your computer for other things while your TNC acts like a packet answering machine for you.

The TNCs I've tried have buffers of 3K or more (depending on the software version). In most cases, this is adequate for several connects. On connecting, a person can leave a short message for you, and when their STA (status) light goes out, they can disconnect.

I disconnect the RS-232 from the computer because sometimes the computer will send a pulse out the interface during power up. This might trigger a Ctrl-Q, and the contents of your TNC would go straight into the bit bucket.

Therefore, follow this procedure to check your TNC when you come back: Power up the computer and go into your terminal program. Set up a "capture file" to disk, or turn your printer on and enable printing. Now reconnect your RS-232 cable, and press Ctrl-Q. Everything should come spilling out of the TNC. (You may also have to press Ctrl-C before it will start.)

The first thing out is the date and time that you suspended your TNC. (We did this operation so that, if nobody connected, all we got was the date and time.) If you do not get this, you'll know that the buffer was lost. This could be due to a glitch on the interface, as mentioned, or a power surge.

If you don't like plugging and unplugging your RS-232 cable, buy a serial switchbox. I have mine connected to switch between my PK-232 and my phone modem. This saves wear and tear on the connectors, and I don't have to reach behind the equipment. 73

David WB6WKB has been a ham since 1977 and active in packet for several years. A software designer, his other interests include hiking, stargazing, desert geology, and plants. His address is PO Box 7883, Van Nuys CA 91409-7883.

Put Your IC-22S on Packet

Dust it off and dedicate it to 2m packet!

by Michael S. Dooley KE4PC

Are you tired of tying up your synthesized radio on packet? If you have access to an ICOM IC-22S, a fast and easy fix will get it on this fascinating mode.

With the help of the schematic, find the Reference Oscillator/Divider. This is a 7.68 MHz crystal. Replace that with a 5.12 MHz crystal. This lets you tune the 22S in 10 kHz steps.

The crystal is available through several advertisers I've seen in computer magazines, as well as from any of the crystal manufacturers. I got mine from International Crystal in Oklahoma City. If you order from a manufacturer, include the loading capacitance. Send them a copy of the IC-22S schematic, and the manufacturer will figure out the loading for you. (I didn't know what the loading was, and so asked for a 20 pF one, which works fine.)

Now just follow the Table to configure the diodes for the packet frequencies on which you want to operate. That's it!

Table of Diode Settings for the IC-22S

Frequency	D7	D6	D5	D4	D3	D2	D1	D0
145.00	0	0	1	1	1	1	0	1
145.01	0	0	1	1	1	1	1	0
145.02	0	0	1	1	1	1	1	1
145.03	0	1	0	0	0	0	0	0
145.04	0	1	0	0	0	0	0	1
145.05	0	1	0	0	0	0	1	0
145.06	0	1	0	0	0	0	1	1
145.07	0	1	0	0	0	1	0	0
145.08	0	1	0	0	0	1	0	1
145.09	0	1	0	0	0	1	1	0
145.10	0	1	0	0	0	1	1	1

(0 = diode not installed; 1 = diode installed)

Drawback?

The only problem is that, with the new crystal, the IC-22S works only from just below 145 MHz to 146.94 MHz, and the offset function gives only a definitely non-standard ±400 kHz split. But, what the heck!—this rig was likely busy taking up space on a shelf, while you were tying up a perfectly good synthesized split operation rig on packet. I set my channels as 145.01 MHz on channel one, 145.02 MHz on channel two, 145.03 on channel three, and so on. Works great!

The author may be reached at 3801 E. 14th #1401, Plano TX 75074.

KAM Box

Packet and WEFAX for the lazy.

by Joe Davidson N4AQG

I recently bought a Kantronics KAM for the shack. I had owned a Kantronics UTU and liked their product, so when the "packet-bug" munched on my hamming spirit I went for the KAM. With the KAM I have been able to keep all my favorite modes, plus enter into the new worlds of packet and WEFAX.

Most of my projects around the shack are driven by the desire to reduce excess motion or effort. This project is no exception. If necessity is the mother of invention, then laziness is its father. I have a good share of the latter.

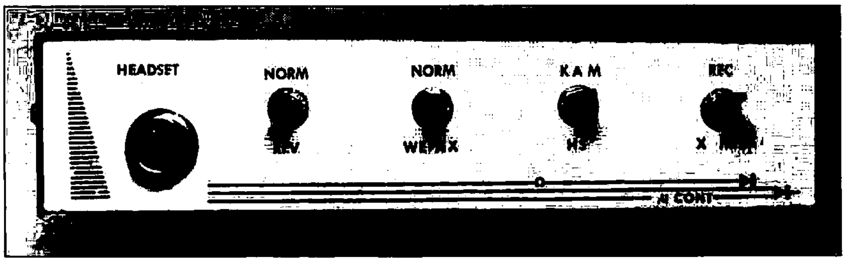


Photo A. Front panel.

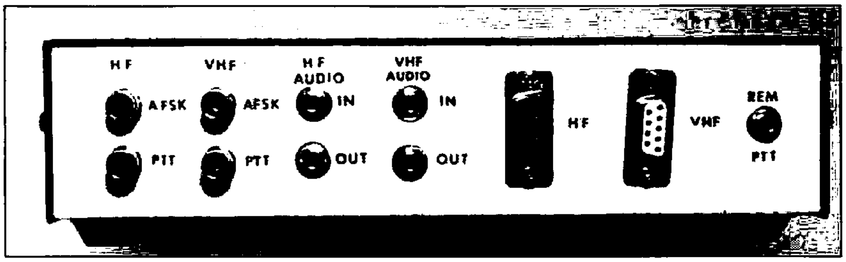


Photo B. Back panel.

Alterations for the Lazy

To copy WEFAX, I had to unplug the HF audio from the HF port and plug it into the VHF port. Then I decided I'd like to work the local VHF RTTY repeater. Kantronics routes the RTTY AFSK through the HF port. Hmmmmm. I could swap the audio ports, but what about the AFSK and PTT? Little idea-gremlins began to scurry around the back of my mind.

I've built several switch boxes in the past so I knew that there was a way around this problem. Out came the paper and pencil, and the drawing began. Figure 1 shows the result.

As I drew, a few ideas bobbed to the surface. I use the phone patch input on my FT-767 GX to input the KAM HF port transmit audio. At a recent hamfest, I bought a used Telex boom mike headset. Why not find a way to use it? Thus, the four-pin mike connector, the remote PTT jack, and the XMIT/REC switch on the front panel.

This box allows me to switch the HF audio alone to the KAM VHF port for WEFAX. It will also reverse the HF and VHF audio, AFSK and PTT to output RTTY on VHF. With a flip of a switch I can use the Telex headset on HF for contesting, DXing, or just plain old gabbing.

Drilling the Connector and Switch Holes

As the parts list reflects, you can buy almost all the parts at your local Radio Shack store.

I chose the cabinet because it would fit into the shack in a minimum of space, and because it had a clean, professional look. Plus, I wanted the shielding properties of a metal case. This particular case has a nice addition—plastic film on the outer surface of both halves.

> ***"If necessity is the mother of invention, then laziness is its father."***

This allows you to center punch and drill holes without scratching the surface. You can then peel the film off and label your box on a clean, unscathed surface.

I measured and centered the hole locations for the switches and jacks on both panels. Then I cut a wooden block from a scrap two-by-four to fit snugly between the front and back panels. This block will support the panels so they won't bend when punching or drilling. Moving the block under each location before drilling reduces the lip-burr formed by the bit on the inside of the hole.

I center-punched the drill points and drilled first with a 1/8" drill. I used progressively larger bits until the opening was large enough for the collar of the switch or connector to fit through.

To make the DB-9 connector openings, I used a different method. First I drew an outline around one of the connectors at the desired location, then drilled a 1/8" hole in the center of the marked opening. Then I enlarged this hole in two or three stages to ¼". Among the tools on my workbench is a piece of magic called a "nibbler"—small shears that let you accurately make your holes.

I chose the DB-9 connectors for several reasons—they have good shielding properties, and are becoming the connector of choice for serial ports.

Label Pressing and Lacquering

The next step was to dig out the sheets of dry transfer letters I bought from an electronic supply house. I used these to label the switch and connector positions. The package of letters contained several preformed electronic terms, as well as an abundance of letters for composing your own. If you can't find these letter sheets at an electric supply house, office supply and art supply stores carry dry transfer letters in several sizes. You might want to experiment with them a little on a piece of white paper. Make sure there is a hard surface under the paper. Rub over the letters several times with a wooden stick. (A pencil-shaped orangewood stick came with my sheets.) Then peel the backing away,

Continued on page 46

Number 11 on your Feedback card

One-Chip RS-232 for the C-64

Easy and inexpensive RS-232/TTL level interface.

by Mike Kabala KB0CDQ

I was bitten by the computer bug long before becoming involved with ham radio. Consequently, after I got my license, I was determined to find ways to combine these two interests. Noticing that many hams used Commodore 64s as packet terminals, loggers, Morse code tutors, and several other things, I decided to put mine to good use and connect it to some of my other equipment. I wanted to use the computer's serial port since that would allow me to connect it to modems, printers, packet TNCs, and anything else with an RS-232 serial port.

But What Is RS-232?

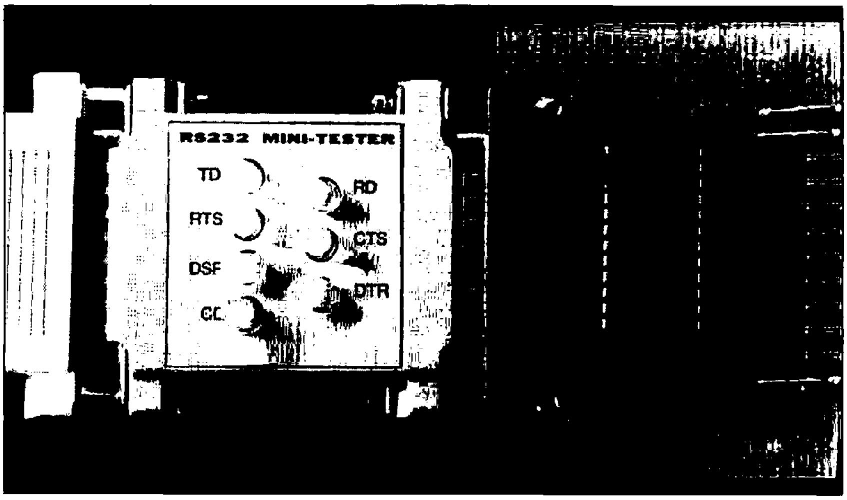
RS-232 is a standard for connecting digital devices together so they can communicate with each other. It was adopted by the Electronics Industries Association (EIA) to make it easier to connect devices made by different manufacturers. The standard defines 25 signals that can be used to establish a protocol between the devices connected. Most equipment uses only a few of these signals. The IBM PC-AT, for example, uses nine, which are attached to a nine-pin connector instead of the traditional 25-pin connector.

When Commodore introduced the C-64 home computer, the company included the same nine signal lines on the computer's serial port. As many owners already know, however, hooking up the C-64 to another device with an RS-232 port is more involved than simply connecting a cable between the two. While the Commodore's signals agree with those defined in the EIA standard, the electrical properties of those signals do not. Commodore's signals are TTL level signals, which means that a signal of 0 V to +0.8 V represents a logic zero, and a signal of +2.4 V to +5 V represents a logic one. The RS-232 standard, on the other hand, represents a zero with a signal of +3 V to +25 V and a one with a signal of −3 V to −25 V.

To make matters worse, the only DC voltages present on the Commodore 64's user port connector (the one containing the TTL level signals) are ground and +5 V. The chip normally used to convert TTL level outputs to RS-232 level outputs is the MC1488, but this chip needs both positive and negative power supply voltages to work properly.

What I set out to do, then, was to find a way to convert all of the Commodore's signals from TTL level to levels that agree with the EIA standard. Furthermore, I wanted to do this using as few components as possible. After asking around a bit, I heard that a company called Maxim Integrated Products made some chips that operate off of a single +5 V supply. In fact, one of them, the MAX232, is used in Heath's Pocket Packet TNC.

While most of these chips require external capacitors, the MAX235 does not. Furthermore, the MAX235 has drivers for five outputs and receivers for five inputs. Since the Commodore 64 has three outputs and five inputs at its serial port, I realized that I could build the entire interface with only one chip!



An RS-232 mini-tester is plugged into the RS-232 port for testing.

Theory of Operation

The MAX235 uses two on-chip charge pump voltage converters to transform the +5 V power supply into +10 V and −10 V. The +10 V and −10 V supplies are then used by the chip's five line drivers to convert the TTL level inputs to +10 V and −10 V RS-232 signals. The receivers use the +5 V supply to convert RS-232 level signals back into TTL level signals. The circuit shown in Figure 1 simply connects inputs to line receivers, outputs to line drivers, and +5 V and ground to the chip's power supply pins.

The MAX235 chip also contains an enable pin and a shutdown pin. The enable line is active low (a TTL zero signal enables the chip), so it has been connected to ground, permanently enabling the outputs of the line drivers. A TTL one level signal on the shutdown pin causes the chip to go into a low-power mode when not in use to save power in battery-powered applications. Since this is of no concern in this project, shutdown has been

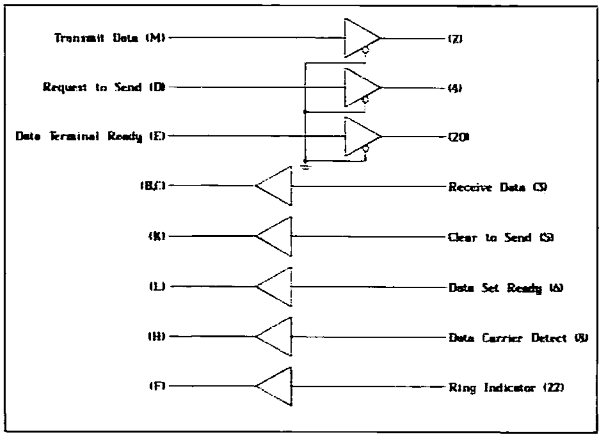


Figure 1. MAX235 IC inputs and outputs.

disabled by connecting it to ground.

Construction

This project is a snap to build, especially if you heed the following tips.

After etching the board, use the four crop marks on the corners as a guide for trimming it. I used a razor saw to trim mine. While the width isn't that critical, the front and rear edges of the board could interfere with the connectors if not properly trimmed. Take care, though, when trimming the edge closest to the DB25 connector; the traces come very close to this edge.

If your male DB25 connector has mounting holes, by all means use them. If, like me, you are constantly joining things and then taking them apart, this connector and the card-edge connector suffers a lot of wear and tear. Even if the installation is permanent, normal use can still strain the connectors. Over time, mechanical stress applied directly to the solder connections will cause them to separate.

The part of the board on which the card-edge connector is attached has been designed for maximum flexibility in choosing a connector. It must, of course, contain two rows of 12 contacts of 0.156-inch centers, but the solder side of the connector can be either the right-angle type or one with straight contacts. The right-angle type is better, since you can bolt them directly to the board, adding to its durability. For this, I provided two sets of hole patterns, one for 0.150-inch spacing between rows and the other for 0.200-inch spacing. Use the set that matches your connector and ignore the extra row of holes. If possible, drill mounting holes for bolting the connector to the board.

If your connector has straight solder tails, place the board between rows of contacts and solder the side touching the copper into place. You will have to drill holes and attach jumpers to reach the other row of contacts. Only three of these are needed—1, 2, and 12—since the other pads have no leads attached to them.

I recommend using a socket for the MAX235 chip. With it, it's easier to check for solder bridges before inserting the chip. Be sure that the chip is oriented correctly, so as not to damage it when applying power.

The two jumpers are optional. They connect pin one (protective ground) of the DB25 connector to pin seven (signal ground). Occasionally, these need to be tied together. (Again, I have never known this to be the case, but it might occur in the future.) Solder a wire between the two terminals of JP2. The terminals of JP1 are on .10-inch centers so that a removable jumper plug can be inserted. Solder two jumper pins to these holes.

Testing and Using the Device

Once you have soldered all components into place, attach a jumper plug at JP1. If you are using a socket, leave the chip out for now. Check for a solder bridge across the power supply by connecting an ohmmeter between pins one and two of the card-edge connector. In a similar manner, check for bridges between the pins of the card-edge connector,

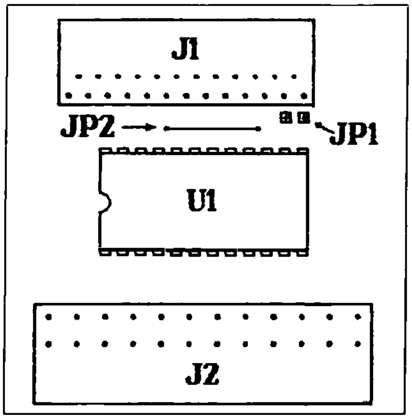


Figure 2. Interface component layout.

between the pins of the DB25 connector, and between pins of the chip socket. There should be a short between pins one and A, pins 12 and N, and pins L and M of the card-edge connector. There should also be a short between pins 21 and 22 of the chip socket. No other shorts should exist between any two pins of the same connector.

When you have removed all solder bridges, insert the MAX235 into the socket, taking care to observe the proper orientation. Make sure that all pins are in the socket and that no pins are bent under the chip. Next, insert the card-edge connector into the user port of your Commodore 64 with the chip facing up. Plug an RS-232 mini-tester (available at Radio Shack) into the DB25 connector if you have one.

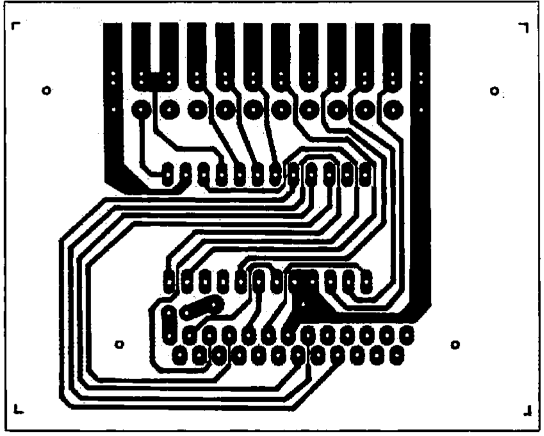


Figure 3. PC board foil diagram for the interface. Not a lot of part stuffing here!

Parts List

Part	Description	Cost
U1	MAX235 RS-232 driver/receiver	$25.00
(U1)	Socket for U1	$ 1.00
J1	Male DB25 with right-angle header	$ 4.00
J2	Card-edge connector 12-position dual-readout on 156 mil centers	$ 3.50
–	Printed circuit board (etched)	$10.00
JP1	Removable jumper	$ .50
JP2	Wire jumper	$ .01
–	Solder and mounting hardware	$ 1.00
MAXIMUM total cost (assuming NO junk-box parts):		$45.01

Apply power to the Commodore 64 and observe the mini-tester. The TD, RTS, and DTR indicators should be lit. All others should be off. If you do not have a mini-tester, place the ground lead of a DC voltmeter on pin seven of the DB25 and check for a voltage of about +10 V at pins two, four, and 20.

Now, turn off the Commodore 64, attach the mini-tester to the device you wish to connect to the computer, and apply power to the device. If the RD indicator lights and TD, RTS, and DTR remain off, you can probably connect the Commodore to the device with a straight RS-232 cable. If RD remains off and TD comes on, you will need a null-modem. RD is on pin three of the DB25 connector.

There are many types of null-modems in common use, so consult the manual for the device to be connected to determine which type you need. If there is more than one diagram, use the one shown for an IBM PC.

Now turn off both the computer and the device and connect them via their serial ports. Turn on the device and the computer, as indicated in the device manual, and attempt to send and receive data between the two machines. (If you are attaching a printer, try sending data only.) You should be able to get your new port working without too much trouble by following the instructions in the manual.

Summary

I have built three of these interfaces so far. The first one was installed *inside* a Commodore 64 and brought out to an IBM PC-AT style DB9 connector attached to the side of the computer. I have used it, at various times, to attach the computer to a packet TNC, to an IBM PC, and even to an Apple Laserwriter printer running at 9600 baud. (Yes, the plural of baud is baud!) The second one is being used by a friend to connect his Commodore 128 computer to his laser printer. I keep the third one on hand for use with my Commodore 64C. I have had no problems with any of these interfaces, and they are very easy to build, so warm up that soldering iron!

About Parts

There's just one hitch: I have checked several sources and have not yet found anyone interested in providing the MAX235 chip in single unit quantities. It is possible to get ten or more, however. Assuming at least ten people will want to build this project, I will make the chips available for $25 each. I will also supply pre-etched circuit boards for $10 each and complete kits for $50. Send a check or money order in U.S. funds to *Mike Kabala KB0CDQ, 144 W. Spring Street, Eldridge, IA 52748.* ■

Packet Radio in Japan

Bits of information on packet in the land of the Rising Sun.

by David Cowhig WA1LBP

In the June 1989 issue of *CQ Ham Radio* (Japan), Mr. Inoue JR1VMX points out that about 50 Japanese hams, mostly in the Tokyo area, now use the 9600 baud FAX modem chips made by Rockwell (the R96MD or R96FAX) or by Yamaha (the YM7910) to operate 9600 baud packet. These chips have become widely available with the proliferation of G3 9600 baud FAX machines. JA8IJY and JA6FTL successfully demonstrated G3 ham radio facsimile at 9600 baud on 21 MHz SSB and 29 MHz FM. JI1FGX and JA1VAS have developed an Ethernet controller and microwave equipment for full duplex communications at 10 megabits per second at 10 GHz, based on conventional wired LAN (local area network) technology. Important software upgrades have been made to several types of TCP/IP radio computer network systems for rapid and efficient distribution of news along networks such as the JK1RJQ, JK1LOT Terakoya, and NOS TCP/IP systems.

A Little Geography

Japan, a country about the size of California, has 1.6 million hams (ham operator licenses last a lifetime in Japan) and about 700,000 station licenses (station licenses are renewed every five years) concentrated mostly along the seacoast on either side of the mountain ranges in the interior of the country. As in California, the population density along the coast (about 40 million people live within 100 miles of Tokyo) and the advantages of high repeater sites in the mountains contribute to the popularity of the VHF and UHF bands. Few digipeaters and FM repeaters use the very crowded 144–146 MHz band, but there are hundreds of repeaters and digipeaters on both the 430 MHz and 1200 MHz bands.

Can't Take Just One Byte

For the English language, we need represent only 26 letters of the alphabet in upper- and lower-case, the numbers zero through nine, and assorted symbols—all of which fits comfortably in 256 combinations. This lets us use only eight-bit bytes to represent a character.

Not so for the Japanese, who commonly use 2000 kanji characters and two sets of a 51 character phonetic syllabary. Japanese word processors and packet controllers (TNCs) use two bytes to represent each of 6000 characters according to the JIS (Japan Industrial Standard) code. Shift-JIS uses two eight-bit digital blocks to create a 16-bit expression for a single kanji character.

FAX in Japan

Talking and sending written messages is fun, but how do you send a circuit diagram, a map, or a drawing to your fellow hams? Well, facsimile and packet image communications have become popular in Japan. Many Japanese hams exchange drawings and maps by adapting the very popular G2 (minifax) telephone FAX machines for radio use. As the speed of these FAX machines increases, many Japanese hams buy inexpensive used FAX equipment. Some hams operate 4800 baud facsimile machines which can send and receive a FAX graphic in less than one minute. Keizo Fukunishi JA8IJY demonstrated a simple interface circuit for 9600 baud telephone FAX machines to put them on HF SSB and FM at 9600 baud, and a tuning circuit for receiving 9600 baud FAX signals. Transmission speed of these G3 FAX machines can be stepped down as low as 2400 baud if necessary.

> *"Shift JIS-uses two eight-bit digital signals to create a 16-bit expression for a single kanji character."*

Japanese hams are exchanging vivid, high resolution color graphics by packet radio using the North American Presentation Level Protocol Syntax (NAPLPS). Akihisa Kurashima JM1VSP wrote an implementation of the Telidon NAPLPS videotex system which runs on IBM PCs with CGA or black and white monitors as well as on the NEC PC-9801 and several other Japanese computers. NAPLPS uses the geometric method to create drawings using graphics commands.

NAPLPS graphics data files are much smaller than those of drawings made using the photographic bit-by-bit method. NAPLPS can switch new character sets in and out of the 256 character set which can be specified using one byte. Thus, NAPLPS can use more than 256 characters in drawing pictures using supplementary character sets which may be NAPLPS-standard, or user-defined. A packeteer can use the operation codes (op codes) of the Picture-Description set to perform operations such as drawing lines, arcs, rectangles, selecting which color to use, etc. The op codes and the character sets make it possible to send a high resolution graphics image using far less information than would be required to send the same image by a video system (slow-scan or fast-scan TV).

Japan's Packet Wish List

Today's packet dreams shape tomorrow's packet future. What are some Japanese packet dreams? Mr. Inoue JR1VMX:

"Packet radio is the second great revolution in amateur radio (the first opened up the shortwave bands). Packet radio brings hams together in a unique way. We need each other to maintain and operate the packet networks if packet is to work. Thus, we have a strong interest in improving the technical understanding of our fellow hams. The arrival of 9600 bps one-chip modems, and especially the successful experiments of Mr. Ueno JI1FGX with 10 megabit per second data transmissions at 10 GHz, open up new possibilities. Some of these are fast-scan TV transmission via packet radio and improved performance for today's TCP/IP news distribution networks and their interfaces with packet BBS. Packet databases and voice data transmission are becoming more practical. Rapid advances in software, hardware and network organization are making this a very exciting time for ham radio. We are reaching towards our goal of free and reliable communications among all the hams of planet Earth." 73

Dave Cowhig WA1LBP is 73 Magazine's Japanese translator. Contact him at 6317 May Boulevard, Alexandria, VA 22310.

Standardizing the Radio/TNC Interface

Patch any rig to any TNC or data controller in just a few moments!

by Brian Lloyd WB6RQN

If you're like me, you want your packet station to perform well. To that end, you've carefully constructed a cable that connects your TNC to your radio. The cable has the appropriate TNC connector on one end and the appropriate radio connector on the other. You've also carefully adjusted your TNC to produce the proper signal level to modulate your rig to precisely 3 kHz deviation. The result is that everybody can copy your packets.

Now you participate in a simulated emergency test, arriving, setting up, and operating. Uh oh, the rig dies, and you have to make do with a different one. Thirty minutes, several clip leads, and much level-pot diddling later, you're back on the air—except no one is sending you any more traffic. It's all going to the voice operators, since their stuff was working and yours wasn't.

Or maybe, like me, you have five TNCs and five radios. Life can get a little complicated unless you dedicate each TNC to a particular radio. What if you want to experiment, or just recover from a radio or TNC failure? You're out of luck.

The Solution

Well, I got tired of both these situations and came up with a solution: a standardized cabling scheme that completely hides the differences between my TNCs and radios. It makes the radios think all the TNCs have the same connector, pinout, and signal levels and, likewise, makes the TNCs think all the radios have the same connector, pinout, and signal levels.

If this situation actually existed, only one type of interconnect cable would be required between the TNCs and radios. In the real world, the situation can be mimicked by having two cables for each installation, one for each radio and one for each TNC. The cables then connect in the center using a standard connector.

The Standard Interface

To do this, I first had to define my "standard" interface. I chose a DB-9 connector, since they're readily available (Radio Shack carries them) and they're available with shielded hoods, so it's easy to construct a fully shielded cable assembly. Figure 1 shows the standard interface connector I designed and the signals passing through it.

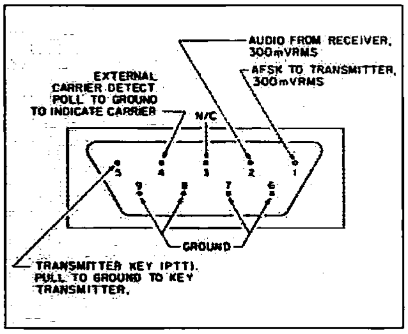


Figure 1. The author chose the DB-9 connecter as the "standard" interface connector, because of its ubiquity and good shielding properties.

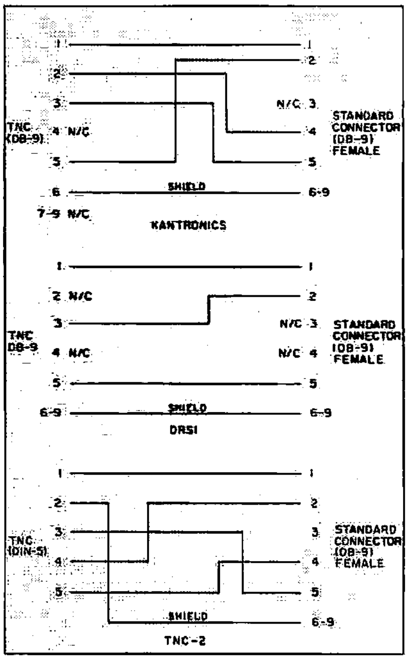


Figure 2. Schematics for patching the "standard" interface connector to three popular TNCs.

The TNC Cable

With the interface already designed, your next step is to construct the TNC cable, since it's the most straightforward. This cable will have the appropriate TNC connector on one end—DIN-5 for TNC-2; DB-9 for TNC-1, DRSI, or Kantronics; and so forth—and a DB-9 "standard" connector on the other. Figure 2 shows the schematics for several popular TNCs.

Because TNCs are both sensitive to RF and wonderful producers of EMI, be sure to use a well shielded cable and use ferrite beads to head off the flow of RF. I put a single large bead over the whole cable to reduce or eliminate RF from the outside of the shield.

Once the TNC cable is finished, you must adjust the TNC to produce the "standard" transmit signal level. I chose 300 mVRMS because it should be more than sufficient to drive any radio. Most TNCs include a trimpot to set the transmit audio level. Simply adjust the pot to produce a 300 mVRMS signal into a 500Ω load.

If you have a Kantronics TNC, you'll have to modify it slightly, using a "standard" mod described in the Kantronics documentation. Kantronics uses a jumper to select one of three transmit signal levels. Choose a resistor value for one of the jumper positions that will set the output level to 300 mVRMS.

The Radio Cable

Now to construct the cable that hides the differences between radios. This cable is a bit more complicated, since it must map the standard pinout to the pinout of the transceiver's connector, attenuate the standard 300 mV signal level to the level expected by the radio, and deal properly with the different PTT schemes.

The biggest problem is attenuating the

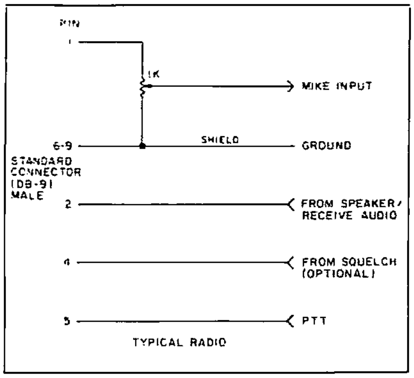


Figure 3. Radio interface cable diagram for many types of transceivers.

signal to the proper level so that, in the case of a VHF or UHF NBFM radio, the high tone generates 2.5 to 3.0 kHz of deviation. I usually start out using a trimpot to determine the proper amount of attenuation, and then replace the trimpot with two resistors. As long as you don't change the deviation control in the radio, the cable will always ensure proper modulation.

> ***"Because TNCs are both sensitive to RF and wonderful producers of EMI, be sure to use a well shielded cable and use ferrite beads to head off the flow of RF."***

Most radios use the same technique for keying the rig: They pull the PTT line to ground. This means that all you need to do is route the PTT line from the TNC to the radio's PTT line.

Some radios, notably handhelds, have a different PTT control scheme. ICOM uses continuity to ground from the center pin on the mike jack to key the transmitter. A Kenwood is keyed when the mike ring connector is connected to ground (the audio-out or external-speaker ground).

Figure 3 shows interface cable schematics

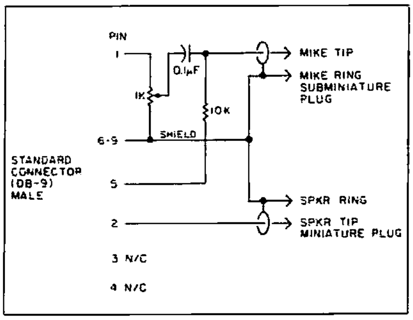


Figure 4. . . . and for an ICOM HT. . .

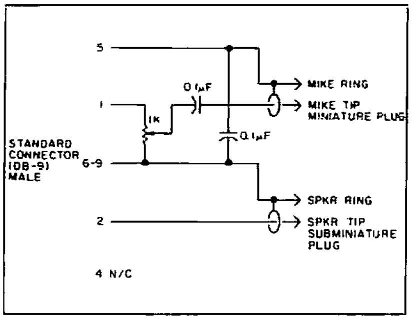


Figure 5. . . . and for the Kenwood TR-2500 HT.

for a typical radio, Figure 4 shows the same for an ICOM HT, and Figure 5 shows the same for a Kenwood TR-2500 HT. Notice that each cable includes a trimpot to set the signal level. Adjust the pot for 3 kHz deviation of the transmitter when the standard level of 300 mV is applied to the cable. After adjustment you can measure the trimpot and replace it with two fixed resistors to make your cable more compact.

When you get your setup working, swap TNCs and radios with friends to make sure everything is truly universal. From then on you can rest assured that making changes in your packet station will be a "plug and play" operation! ■

Brian Lloyd WB6RQN has pursued amateur radio enthusiastically since age eight. He recently co-founded Sirius Systems, a networking business in Petersburg, Virginia. You may reach Brian at: 5712 Stillwell Rd., Rockville MD 20851.

73 Review *by Philip R. Karn, Jr. KA9Q*

GRAPES, Inc.
PO Box 871
Alpharetta GA 30239-0871
Price Class: $250, in kit form

GRAPES 56 Kb Modem

We've come a long way from 1200 baud packet.

How would you like to be able to send the equivalent of a standard 5.25" IBM PC floppy disk (360 Kbytes) by packet radio in less than two minutes? How about transmitting telephone-quality digital voice over the air? Sound too good or expensive to be true? Not at all! It's being done right now, with equipment and software available to any interested amateur.

The key is the 56 Kb/s modem designed by Dale Heatherington WA4DSY and distributed by the Georgia Radio Amateur Packet Enthusiasts Society (GRAPES). Since its unveiling at Dayton in 1987, this modem has progressed through the experimental and beta test stages and is now in routine production and use.

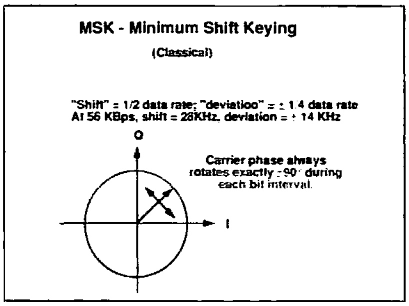


Figure 1. MSK, a form of Frequency Shift Keying (FSK), uses the smallest possible mark/space frequency shift for the data rate in use. This keeps the signal bandwidth to a minimum.

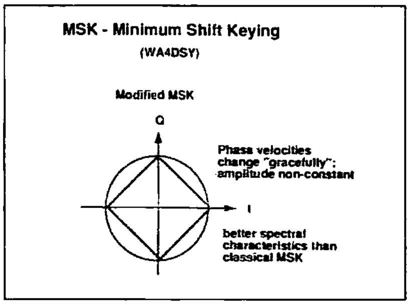


Figure 2. The 56 Kb modem uses a modified form of MSK.

Keying Scheme

The WA4DSY modem uses a modified form of Minimum Shift Keying (MSK) (see Figures 1 and 2). MSK is just a special form of Frequency Shift Keying (FSK), well known to every HF RTTYer. As the name implies, though, MSK uses the smallest possible mark/space frequency shift for the data rate in use, keeping the signal bandwidth to a minimum.

In RTTY terms, the carrier "shift" in Hz is equal to one-half of the data rate in bits per second; at 56,000 bits/sec, the mark/space shift is 28 kHz. In FM terms, the "deviation" of the signal is plus and minus one-quarter of the data rate, or ±14 kHz at 56Kb/s. If you select a different speed In the modem, the shift changes automatically; the transmitted signal is generated digitally in a state machine, so you can't get it wrong!

The WA4DSY Modem Kit

The kit includes three PC boards: transmit encoder, receive decoder, and RF board, plus all necessary board parts except the channel crystals. Unlike virtually all other amateur packet radio modems, the WA4DSY modem is not an add-on to a standard voice transceiver. Instead, it operates with a VHF or UHF transverter (transmit/receive converter) such as those made by Microwave Modules or SSB Electronics. You must buy the transverter separately.

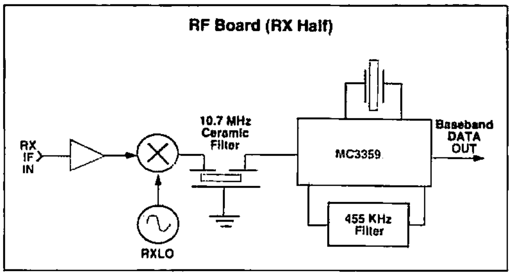


Figure 3. The receive portion of the WA4DSY modem design.

Transverters have the needed bandwidth to pass the high speed modem signal (75 kHz). Also, they are typically cheaper than full-voice transceivers because they lack an audio section, synthesizer, and the other extras that aren't necessary for dedicated packet operation. The RF section of the WA4DSY modem operates near 28 MHz, so you can use it on any band where you can use a transverter designed for a 10 meter transceiver. (Because of FCC bandwidth limits, however, you may only use this modem at full speed on frequencies above 220 MHz in the US. See section 97.69 of the regs.)

The RF modulator produces approximately 1 mW (0 dBm), enough to drive the Microwave Modules transverter, configured for low drive level, to full power. The RF demodulator is sensitive enough to work well when fed directly from a typical receive converter. The transverter must be modified to decrease its transmit/receive switching time, but this is a simple operation involving the removal of a single capacitor.

The WA4DSY modem design is highly modular. You can saw the RF board's receive and transmit into halves and build completely independent receivers and transmitters if you wish (e.g., for dedicated, full duplex links). See Figures 3 and 4.

The digital side of the modem provides six interface signals, three each for the transmitter and the receiver. All signals are TTL levels; if the host computer uses RS-232 signals you must either modify it to produce TTL or insert RS-232/TTL level converters.

As standard with commercial high speed synchronous modems, the WA4DSY modem provides both transmit and receive bit clocks. This eliminates the need for a baud rate generator in the host computer interface. It also means you can use older and less expensive HDLC chips like the Zilog SIO without having to provide a "state machine" circuit like that in the TAPR TNC-2 for recovering clock from the receive data stream.

In addition to the data and clock input/output signals, the WA4DSY demodulator also accepts a Request-to-Send (RTS) signal for keying the transmitter, and it provides a Data Carrier Detect (DCD) signal.

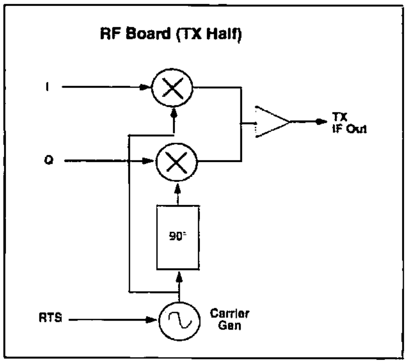


Figure 4. The transmit half of the WA4DSY modem. Since the design is modular, you can saw the RF board in half to set up a completely independent receiver and transmitter section.

Construction and Alignment

The kit provided by GRAPES includes complete documentation and all parts required to populate the three main boards except for the channel crystals (two are required: one for the transmitter and one for the receiver). I found the kit convenient and easy to assemble, particularly after having built two of the early "bare beta board" versions of the modem when I had to scrounge for my own parts! Nothing was missing, and I had the boards together in a weekend. The location of each part was silk-screened into the RF and receive decoder cards.

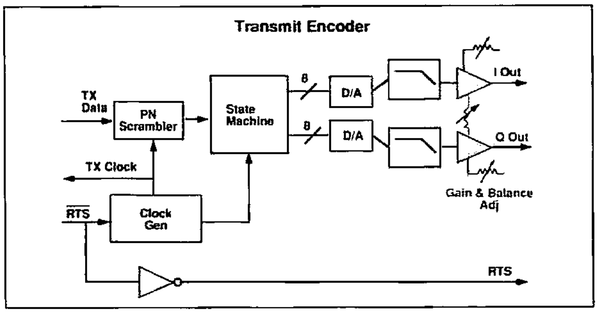


Figure 5. With the parts placement diagrams, it's easy to assemble the transmit encoder.

Although there was no silk screen on the transmit encoder card (see Figure 5), I had no problem putting everything in its place using the parts placement diagrams.

As mentioned earlier, the modem can operate at speeds other than 56 Kb/s. Dale was careful to place all of the speed-determining components on plug-in DIP headers on the transmit encoder and receive decoder cards, so you don't have to unsolder anything to change speeds.

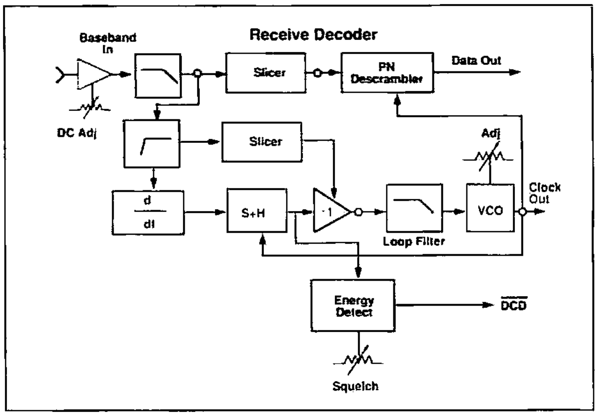


Figure 6. The receive decoder card adjustments are straightforward.

The bandwidth of the receive IF filter on the RF board is fixed, however, so you'd have to do some soldering and recalibrating there if changing speeds. I don't know of too many people, however, who have operated these boards at speeds below 56 Kb/s!

Modem Setup

Alignment of the modem requires an oscilloscope, preferably a dual-trace model. The instructions are fairly clear, and tweaking the transmit encoder card took only a few minutes. The RF card takes a little more work. I was fortunate to have the use of an IFR 1200S Service Monitor to make the alignment of the IF bandpass filter coils in the receiver a two-minute job, but it's not that much harder with just the scope. I did notice something on the IFR's spectrum analyzer while setting the power gain adjustment in the transverter:

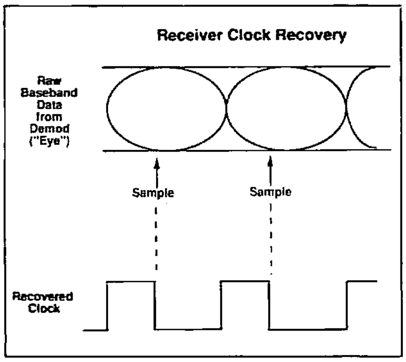


Figure 7. In the clock recovery circuit, the author soldered a miniature 0.1 μF capacitor across the supply and ground pins on the underside of the socket.

If you crank the wick all the way up, the signal sidebands come up noticeably. It's best to sacrifice a few watts to let the transverter have some headroom. The modem signal is a specially modified form of MSK with some deliberate amplitude modulation to reduce the extra sidebands, so you want to operate the transverter in its linear region. If you do this, the spectrum is very clean.

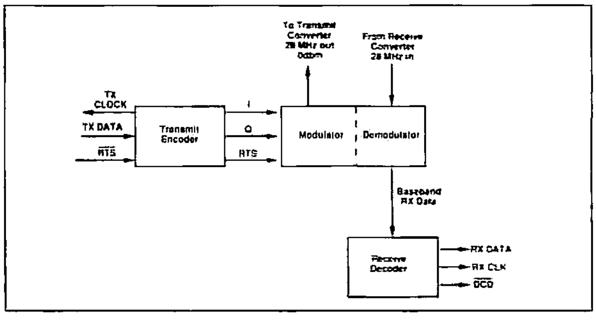


Figure 8. The 56 Kb modem system. The GRAPES kit includes three PC boards: transmit encoder, receive decoder, and RF board, plus all necessary board parts except the channel crystals.

Once the RF board was aligned, the receive decoder card adjustments were very straightforward (see Figure 6). I did have one problem with false triggering in the NE555 IC in the clock recovery circuit (see Figure 7); I fixed this by soldering a miniature 0.1 μF capacitor across the supply and ground pins on the underside of the socket.

Assembly

The GRAPES kit contains no chassis; you have to find one and drill your own holes. I've been using the 10" x 12" x 2" Hammond aluminum chassis, as I can arrange the boards for easy access to the adjustment screws and test points. You can certainly use more compact (or more attractive!) cabinets, if you prefer.

The modem requires a source of ±5V DC, plus whatever the transverter requires (typically +12V DC). I used some small surplus Japanese-made switching power supplies sold by Radio Shack for the bargain price of $5. This was five years ago, and unfortunately they are no longer available. Suitable AC power supplies are certainly available, but if you prefer 12V DC operation, you can use a linear regulator to generate +5V. The modem's −5V requirements are minimal, so a simple charge pump circuit will do just fine.

Up and Running

This modem challenges you to figure out how to move data to and from your computer fast enough! The early experiments in Atlanta with this modem used modified TNC-2s; the mods consisted of beefing up the digital components (CPU, SIO, memory), eliminating the internal Bell 202 modem, and installing a modified copy of the KISS TNC EPROMs. The TNC was then connected to an IBM PC host computer running my TCP/IP package.

This worked, but the serial link between the TNC and host computer was still not fast enough. The cost was unappealing. But if you're interested, the details are included with the modem kit documentation.

Problems and Adaptations

When I obtained my modems a year ago at Dayton, I also picked up a PCPA (PC Packet Adaptor) card from DRSI (Digital Radio Systems, Inc). The PCPA is a plug-in adaptor card for the IBM PC bus that contains a Zilog 8530 HDLC chip, a Bell 202 modem, and associated "glue" parts. Bypassing the modem and RS-232 drivers (a procedure described in the DRSI manual), I was able to connect the PCPA's 8530 chip directly to the modem with a ribbon cable.

Then I wrote a special software "driver" module for my TCP/IP package that accesses the PCPA's 8530 chip directly, passing data at the full 56 Kb/s rate of the modem. It works, but at a cost: because of the high data rate, the computer has its hands completely full whenever the modem is active, transmitting or receiving. Everything else (keyboard

echoing, the time-of-day clock, etc.) momentarily grinds to a halt!

This is not ideal, so work is underway to develop a "smart" card with its own CPU to handle the low-level tasks of talking to a high speed modem, freeing the main CPU for other things. Mike Chepponis K3MC has built a prototype, and my next step is to program it. But until then, we can use the DRSI PCPA and its functional equivalent, the PacComm PC-100. (You can also use a board called the "Eagle card,"once sold surplus by the now-defunct Eagle Computer company, if you can get one.)

Packet in the Fast Lane

It should not surprise you that it's VERY easy to get spoiled by 56 Kb packet! Once you've had a taste, there's no going back. Even my 9600 b/s telephone modem seems slow in comparison, and one wonders how anyone could possibly tolerate 1200 b/s!

But to be fair, 56 Kb is not without its problems.

The first problem is probably fairly obvious: There aren't that many people around to talk to yet! The situation here in Northern New Jersey on 220.55 MHz (the local 56 Kb/s channel) is much like 145.01 MHz was back in 1983. Our 56 Kb network presently consists of KA9Q, WB0MPQ, KA9Q-2 (a digipeater/IP switch) and N2AER; we expect N4HY and N7AKR on the air soon. High speed packet is now at roughly the same stage that 1200 baud packet was in the early 1980s, and with luck it'll become as popular.

The keyup delay required by the WA4DSY modem isn't as small as I would like. We're currently running with transmit delays of about 15 milliseconds. This may seem short until you realize that in 15 ms at 56 Kb/s, you can send 100 characters! Many packets aren't this big, even when you include full TCP, IP, and AX.25 protocol headers.

The data carrier detect (squelch) circuit in the WA4DSY demodulator could probably be improved. Although it works reasonably well (better than the DCD circuits in most slow speed packet modems) it can be tricky to adjust and the threshold sometimes varies due to front end desensing. (Perhaps this is an unfair criticism; I live about 500 feet away from a 220 MHz FM repeater.)

High speed operation requires wide bandwidths. As mentioned, the WA4DSY modem occupies about 75 kHz when running at 56 Kb/s; it is generally operated in a 100 kHz channel. This is about five times the bandwidth of an FM voice channel (20 kHz), so five times as much noise enters the modem receiver's passband as compared to a regular FM voice receiver.

Therefore, the 10 watts of 56 Kb/s RF coming out of my transverter is like 2 watts of FM voice RF—not much. Multipath is also a problem (100 kHz is half as wide as a commercial FM broadcast channel.) Beams and good sites help, but sometimes there is no substitute for a power amp.

An aside: The spectral efficiency of a modem isn't measured by its bandwidth alone, but by the ratio of the bandwidth to the data rate. Although the WA4DSY modem requires five times the bandwidth of a standard 1200 baud packet signal, its data rate is 46.7 times faster. This makes it about 9.3 times more spectrally efficient than the latter.

This wide bandwidth also limits us to 220 MHz and up, both a blessing and a curse. It's a blessing because 2 meters really isn't the proper place for serious packet operation because it's too crowded, at least in densely populated areas like New York. It's a curse because propagation isn't as good on the higher bands, and transverters are more expensive. Nonetheless, we'd better get active there in any event, since spectrum theft by other services can strike at any time. If Docket 87-14 is upheld and we are unable to find 100 kHz of space above 222 MHz, my friends and I are going to have to junk some perfectly good transverters.

The availability of high speed modems, interface cards and host computers does not guarantee maximum throughput; careful network engineering is still necessary. But the WA4DSY modem is a major contribution to amateur packet radio, and it has the potential to be as revolutionary as the original Vancouver and TAPR TNCs.

Phil Karn KA9Q works for Bell Communications Research (Bellcore) designing and maintaining internal networks. He is one of the founding fathers of amateur packet radio, as he co-authored the AX.25 protocol specification. Phil is a member of the Board of Directors of the Tucson Amateur Packet Radio (TAPR) group, and is very active in AMSAT. You may contact Phil at 25-B Hillcrest Road, Warren NJ 07060.

Continued from page 32

Parts List

Part	Use	Radio Shack #
Metal Box	Cabinet	270-272
4-Pin Mike Jack	Headset Jack	274-002
4-Pin Mike Plug	Headset Plug	274-001
DB-9 Female (2)	VHF Box Connect HF Cable Connect	276-1538
DB-9 Male (2)	VHF Cable Connect HF Box Connect	276-1537
Phono Jacks (4)	VHF & HF AFSK & PTT	274-346
1/8" Mini Jacks (4)	VHF & HF Audio In/Out	274-251
1/8" Mini Jack (1)	Remote PTT	274-251
3PDT Mini Toggle (2)	NORM/REV & KAM/HS	275-661
DPDT Mini Toggle (1)	NORM/WEFAX	275-663
SPDT Mini Toggle (1)	REC/X MIT	275-662
Mini Shielded Cable	Wiring	278-752

Misc.: Solder lugs, audio cables, dry transfer lettering, clear acrylic spray paint.

slowly. If part of the letter remains on the backing, lower it back to the surface carefully and rub again. You quickly get the hang of it, and they make a project look very professional.

With the lettering done, I sprayed both surfaces with several coats of clear acrylic. Always test the spray first. All the acrylic sprays I have used so far haven't caused problems, but there are some sprays that make the lettering dissolve and run. Spray several light coats with plenty of drying time in between. You don't want any runs on the front panel!

Installing the Ports and Switches

I let the box sit for a night or two, then mounted the switches and connectors. Once they were in place and carefully tightened down it was time to heat up the old soldering iron.

I used miniature coax for the wiring for several reasons, most of them having to do with RFI (We already get enough noise in our transmit and receive signals.) Ground the shield of at least one end of each wired connection in the box. Remember to first make a good mechanical connection with the wire to the solder lug, then make a good solder connection. Keep all leads as short as possible, making them nearly taut.

Adding Accessories

The Telex headset had a commercial plug on it. I could find no markings as to which pin was for the earphones and which was for the mike. Hanging the earphones on my head and using the ohm position of my multimeter, I checked between the center wire and the shield of each wire. I heard the crackle in the phones. That identified the phone wire. The other was obviously the mike. I wired a common four-prong mike plus to the cable to match the four-prong jack on the switch box.

I took time out from the box to install the DB-9 plugs on the KAM cables. I used the diagrams in the KAM instruction manual to identify the wires. Shielded audio cables from my junk box made the PTT and AFSK cables for both HF and VHF. The FT-767GX uses phone connectors for Patch input and PTT input. For the two meter, I stripped one end of the cables and soldered them to a mike connector.

Checkout

I went back over each wire, one at a time, tracing it in comparison to the schematic. I didn't want PTT voltage going into a receive audio circuit or some other IC eater, chewing up my rigs! Satisfied that it was close to correct, I plugged up the cables and gently powered up the devices.

The buzz saw of packet ripped the two meter speaker and text unraveled across the computer screen. One quick fix, and I ran it through the rest of the modes and found one problem. A quick look and then moving one wire to the other side of a switch fixed that one. Even with my second and third recheck, I had missed that one.

It all worked pretty much as I had expected. The headset worked nicely. With a foot switch plugged into the remote PTT jack I could work DX and log with two free hands.

Using the KAM

Photo A shows the front panel. From left to right:

HEADSET JACK	(P10)	
NORM/REV	(S1)	Switches RTTY between HF and VHF.
NORM/WEFAX	(S2)	Switches the HF audio to the VHF port of the KAM for WEFAX.
KAM/HS	(S3)	Switches the HF receive and transmit from the KAM to the headset.
REC/X MIT	(S4)	Switches PTT.

Photo B shows the connectors on the back panel. From left to right:

REMOTE PTT	(P1)	For a remote switch, e.g. foot switch.
VHF DB-9	(P2)	(Female) connects the KAM VHF port to the switch box.
HF DB-9	(P3)	(Male) connects the KAM HF port to the box.
VHF AUDIO IN/OUT	(P4)	Alternative to using the "Y" cables that come with the KAM.
HF AUDIO IN/OUT	(P5)	As above, for HF
VHF AFSK	(P6)	Transmit audio for VHF.
VHF PTT	(P7)	To VHF rig.
HF AFSK	(P8)	Transmit audio for HF.
HF PTT	(P9)	To HF rig.

Almost Perfect

After using it for a few days, I decided that on my next box I should add another audio input in the back panel for my scanner. Otherwise, I've got what I wanted. It's nice to switch to WEFAX and tune up and watch the scan and then later drop over onto the RTTY repeater and rag-chew for awhile. And, of course, the KAM excels in packet. All this with just the flip of a switch or two! These alterations have made a very nice operating interface just a little more friendly. ■

Joe Davidson N4AQG has been a ham since 1976, and is especially interested in 10m SSB and FM DXing. Joe currently works as a technical advisor in avionics and tactical radio for the Department of the Army. Other interests include computer hacking and landscape painting with acrylics. You may contact him at 1863 Mount Berry Drive, Douglasville, GA 30135.

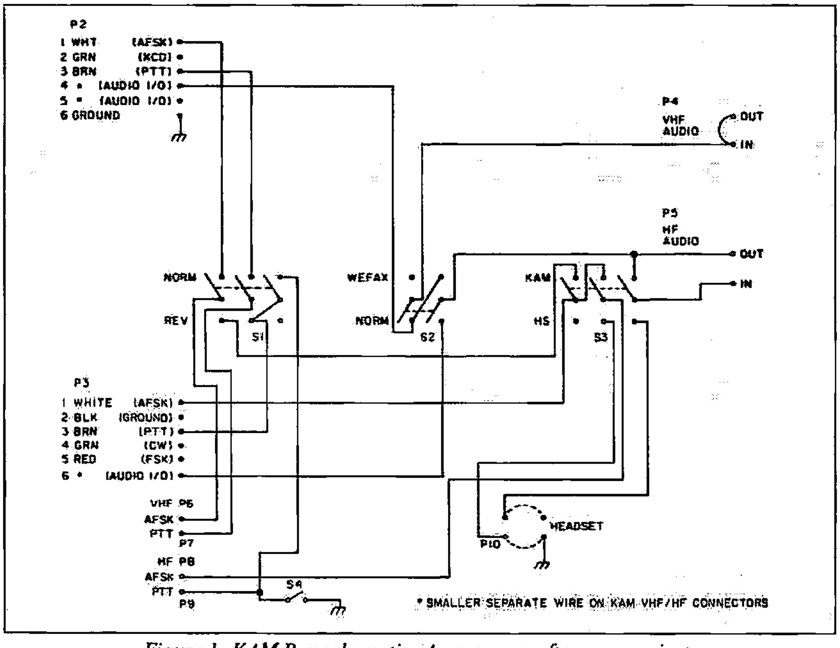
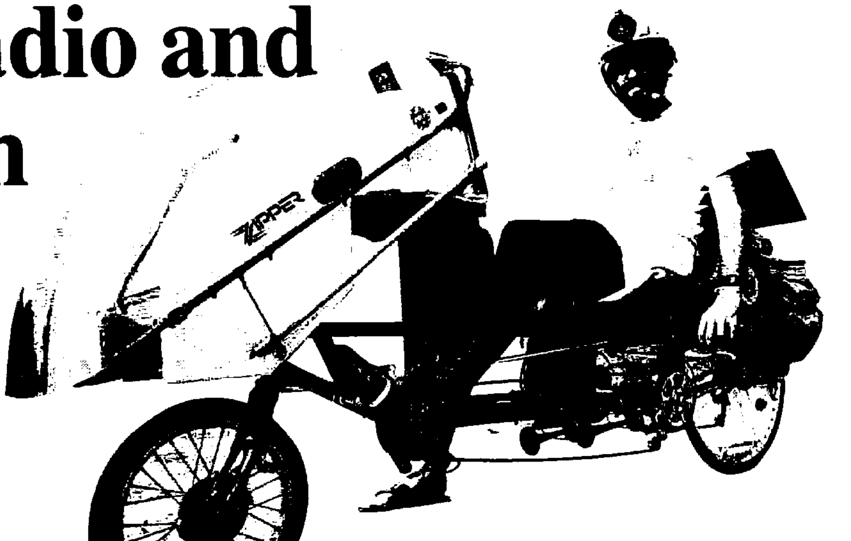


Figure 1. KAM Box schematic. An easy one-afternoon project.

Packet Radio and High-Tech Nomadics



Steve Roberts N4RVE on the Winnibiko II. The new recumbent, the Winnibiko III, will carry both the PacComm Micropower-2 TNC and the MFJ 1278 multi-mode data controller. Apart from "traditional" packeting, Brian will be a roving PBBS, and use a packet link to remotely control the bike's computer/radio system from a laptop.

A sneak preview of the Winnebiko III.

by Steven K. Roberts N4RVE

If you've been reading *73* for over a year, you've already had a look at the Winnebiko II—the computerized, ham radio-equipped recumbent bicycle that I've pedaled 16,000 miles around the United States. And if you were a regular reader of my article series, you even might have wondered what happened; I've received a few pieces of packet mail asking if I've been run over by a truck.

Well, if I've been struck by anything at all, it's the passion to create new machines. Maggie KA8ZYW and I are currently in a yearlong Silicon Valley layover, building all-new bike systems and preparing to hit the road for many years of open-ended international travel. The project has been escalated to a new level, with the design specification now calling for maximum independence from support facilities of any kind. Indeed, this has become an all-out effort aimed at creating a self-maintaining mobile information platform, constantly in communication with worldwide voice and data networks while freely wandering the Earth's surface under human and solar power.

Winnebiko III Architecture

Packet radio is a key component in the system, but before a description of its implementation can make sense, you need a quick look at the whole machine. One disclaimer: This is an overview of work-in-progress, and there may be a few discrepancies between what is stated here and what actually rolls out the door this winter.

There arc two major electronic areas in the new machine. Up front in the streamlined console are all computer and control systems, and back in the solar-roofed trailer are the rackmount ham shack and power management hardware. Between the two sit the wetware information system and bio-engine, coupled to the rest of the machine via a variety of interfaces that include a heads-up display, ultrasonic head-position sensor for display control, speech I/O, handlebar keyboard, active Peltier-effect scalp-cooling system, thumb mouse, and random controls. Oh yes—and pedals.

The controller for the whole machine (one level down from the human, that is) is an eminently hackable CMOS 68000 running FORTH. It's in charge of the local area network that connects all other information systems and 68HC11 microcontrollers, as well as a giant "resource bus" based on Mitel crosspoint switches and AMD programmable gate arrays. Through this array pass all audio, serial, power-control and status signals, making it extremely easy to establish connections between subsystems that I might not originally intend to interface. Also in the console system are a pair of DOS environments for AutoCAD, OrCAD, mapping, satellite tracking, text editing, database management, and communications. On top of this there'll be a significant new machine, still proprietary, that I'll reveal in a later article, as well as a dedicated 68HC11 for data collection and a few stand-alone intelligent devices for navigation, speech, and so on.

> ***"The controller for the whole machine is an eminently hackable CMOS 68000 running FORTH."***

All this provides extensive real-time processing horsepower and a very friendly user interface—with a VGA backlit display, a 640 x 200 LCD for the FORTH, a flip-down hi-res screen, and the heads-up display as graphics options. But now that I can compute as much as I want, how do I communicate with the rest of the world?

The trailer system carries the bulk of the radio gear (not including the cellular phone, the 56-kilobaud spread-spectrum data link, a Swintek full-duplex wireless intercom for security monitoring, and an embedded ICOM µ2AT in the console for bike-to-bike chat). The radio gear takes the form of a shock-mounted 19" equipment rack accessible through a fold-down rear door, along with a collapsible antenna mast for the OSCAR-13 array and whips, a permanent 70cm collinear for Microsat operation, and the usual bag of dipoles and accessories.

The rack-mounted gear includes ICOM's new 725 (modified for low-power drain), a pair of Yaesu multimode transceivers for both OSCAR and terrestrial VHF/UHF operation, a pair of ARR preamps, an AEA ATV transceiver, an antenna tuner and coax patch panel, an MFJ/Bencher keyer, a power-entry module for AC line interface to the bike's 12 volt bus, a regenerative braking controller, yet another 68HC11 for trailer data collection and local control, and two of the bike's three main batteries. Maggie's bike, in case you're wondering, carries a Yaesu 290 and Ranger 3500 for 2 meter and 10 meter multimode operation.

But where does packet fit in all this?

Bicycle Datacomm

For the last three years I've been running bicycle-mobile packet via PacComm's first-generation TNC, the bike's computer, and the handlebar keyboard. This has been a fairly low-level manual operation, with a few tentative stabs at maintaining a mobile BBS, but no real autonomy in the datacomm and message-passing realms.

The new system is different, and uses packet in three ways.

First, I carry both a PacComm Micropower-2 and an MFJ 1278 for "traditional" packet radio use. The MFJ multimode unit, modified with all SMOS components to minimize power drain, is for browsing the HF spectrum in search of interesting FAX, RTTY, and AMTOR contacts. The 35 mA PacComm is for 2 meter packet and has a big FET switch on the modem disconnect to accommodate a TAPR PSK demodulator for the Microsats. In both cases, operation is via the handlebar keyboard and any of the display spaces when I'm mobile, or via a laptop when I'm parked.

The difference between mobile and parked operation has spawned the second major packet addition to the system. Last time, the robust machine was my laptop, and the on-board computer was fairly wimpy. With that setup, I had no particular interest in using the bike machine when parked, and happily immersed myself in the H-P system instead. But now the bike's Ampro 286 with a 40-meg hard disk and 4-meg RAMdisk (along with other extensive processing resources) makes carrying a high-end laptop seem a bit unnecessary. The problem, however, is that I don't particularly want to sit on the bike working for hours when I'm not actually riding it.

The solution is simple. A pair of PacComm surface-mount TNCs—one on the bike and one in my backpack—are linked to each other via 2 watt Maxon business-band UHF data radios (which require a separate license). When I'm off the bike, the only hardware left active is this data link and a security system. If I want to access bike resources for any reason, I can flip open the backpack, bring up a communication program, and sign on from up to three miles away.

The first level of response from the bike is the mini-PBBS in the PacComm, which, unlike the typical TNC, lets me send a data packet that writes directly to a parallel port. A keyword does the trick, booting up the 68000 system through a power controller and presenting me with its FORTH command line. I now have full control of the system and can check telemetry data, dial out via cellular phone, boot up the 286 and access a database, power up and operate the ICOM 725, or send speech strings for local output via the Audapter speech synthesizer. The whole bike, except for the wheels, is completely remote-controlled...for everything is computer-controlled.

The third major packet application on the Winnebiko III involves the orbiting BBSs scheduled for launch this November—AMSAT's quartet of Microsats. The details will clarify as the system comes together, but preliminary discussions indicate that wherever in the world we travel, my bike will periodically run a satellite tracking program, power up the Yaesu system at the appropriate times, scan with the TAPR demodulator's feedback until the bird is acquired, then automatically exchange text files and upload the latest block of telemetry data (including our precise location derived from GPS satellites). All this will be piped through "mission control" in the States, with the data parsed and retransmitted to other nodes as appropriate. It seems likely that this will become a significant component of my non-business E-mail traffic—and provide a spirited demo of Microsat technology: a guy wandering the world on a bicycle easily tracked to within a few hundred feet from someone's ham shack.

Fellow hams, we have some amazing technology in this subculture of ours!

The PR Component

I'd like to make a quick comment on a related issue. Recent discussion on both wireline and packet nets has revealed the disturbing fact that the new director of the FCC is Sharree Marshall, an ex-employee of the law firm that has represented UPS in its successful bid for the 220–222 MHz portion of the amateur spectrum.

We hams have more of a problem than ever. The days of taking spectrum space for granted are quickly passing, as alluring new technologies compete for consumer dollars. The UPS crisis is just the first obvious loss; there are a lot of people out there (and I know some of them) who want—and will aggressively fight for—our space. We have a few advocates in high places, but not enough, and we can no longer assume that someone will take care of the problem for us.

One contribution that every ham can make is *public relations*. I'm doing some by integrating ham radio into a high-tech, upbeat lifestyle and writing about it for non-ham publications. Others can score PR points by fixing public problems, getting school kids excited, passing traffic to world trouble spots, inventing nifty gizmology and making it clear that it grew out of ham radio, publishing callsigns with technical papers, and generally doing anything possible to bring our *image* into the current century.

Yes, it's all image, just like any other kind of marketing. It may at times seem blatant and artificial, but that's how the world works.

Here's the test: Take an average person off the street, expose him or her to a few minutes of typical repeater chatter and HF commentary about weather and equipment, then pose the question, "Which is the better use of a 2 MHz piece of the spectrum, improving the speed and efficiency of your UPS deliveries or giving these guys more room to talk to each other?" Until that average person springs to our defense with the very arguments we've been making to each other for the last 50 years, we have a problem.

This article is ostensibly about bicycle-mobile packet, so with that timely little diatribe about the future of all this equipment I'm pedaling, I'll close. As the next few months pass, you'll be hearing from me in growing detail about the new systems, until we're finally on the road and on the air again... where we belong.

73 de N4RVE

Steven K. Roberts N4RVE, author of Computing Across America and features in 73 Magazine, can be reached at 1306 Ridgeway Ave., New Albany IN 47150.

Improve your TNC's DCD circuit

Make your DCD faster and more discriminating.

by Eric Gustafson N7CL

Proper data carrier detection (DCD) is one of the most important items to consider on any multiple access packet channel. The DCD circuitry for nearly all currently available TNCs are deficient for use on a radio channel. Some are better than others, but most can be dramatically improved. This article shows you how to do just that!

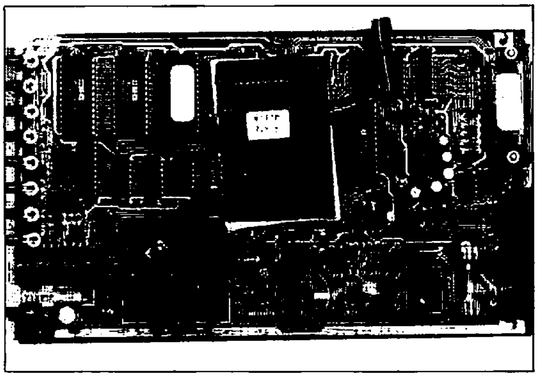


Photo A. The state machine DCD circuit prototype.

Purpose of DCD

The DCD's main function in the TNC modem is to prevent transmission on an occupied channel. If two stations transmit at the same time, a collision occurs, which corrupts the data, which means both stations have to re-send the data. This increases the total load on the channel and reduces throughput for everyone.

What's the optimum DCD circuit for packet radio? It should have these five key features: It must reliably distinguish information from noise; it must transmit packet data uninhibited by an open squelch; its signal should remain valid through momentary fades or collisions; it should tolerate signal level differences; and it must be fast.

The last item is most important. Most current TNCs rely on the rig's squelch to keep noise out of the modem. Many squelches, however, open very slowly. During that time, the TNC may decide to transmit even though someone else has started using the channel.

Existing Methods

There are two principal ways TNCs detect a data carrier on the channel—phase correlated DCD and total audio power based DCD. The first type is inexpensive and easy to use, and is of two primary types. One looks for phase correlated signal power in the audio presented to the demodulator; the other, applied after the data decision, looks for regular transitions in the data stream emerging from the demodulator. A good example of the use of this second type of circuit is the K9NG 9600 bps modem. (For more information, see "Modifying the Hamtronics FM-5 for 9600 bps Packet Operation," by Steve Goode K9NG, in the ARRL Amateur Radio Fourth Computer Networking Conference, pages 45-51.)

The TAPR TNCs use the output of the in-phase channel phase detector of the phase locked loop (PLL) in an XR2211 demodulator to look for power in the incoming audio that is in phase with the tracked FSK signal. Audio signal components (noise) in quadrature phase relation to the tracked signal do not contribute any average power to the detector output signal. This type of detector has a dramatically reduced sensitivity to noise.

The total power based DCD circuit, based on total audio power going to the demodulator, simply measures the total energy in the modem passband. It assumes any signal is a data signal. These circuits are appropriate only for telephone systems which are usually very quiet in the absence of the desired signal.

Either of the two-phase correlated DCD methods is far superior to the total power methods in the radio environment. Both have the ability to reliably indicate the presence of a data carrier, while being able to ignore high amplitude noise that may be present when the desired signal is absent. This characteristic is important because an unsquelched FM receiver typically produces "pink" audio noise whenever the signal is absent. This noise is considerably higher in amplitude than the desired signal.

Apart from the MFJ-1278, I am not aware of any ham packet TNCs that have modems with DCD circuits optimized for the radio environment.

Modifying Popular TNCs

It's not hard to make a DCD circuit that operates in accordance with the above points. If you have a TNC that uses either the

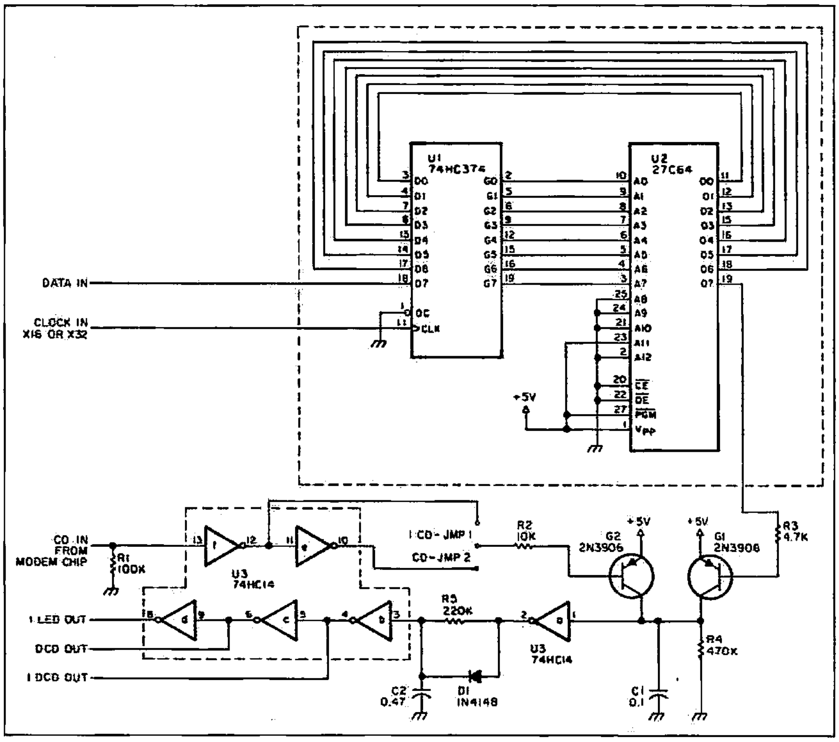


Figure 1. Improved DCD circuit.

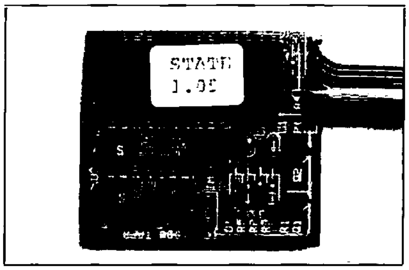


Photo B. The TAPR state machine DCD kit.

AMD7910 or the TCM3105 single chip modem, or if you have a TNC that uses a modem based on audio filters like the PK-232, you can vastly improve the DCD performance of your modem for packet radio. These units all rely solely on total signal power with NO phase correlation as a basis for the DCD decision. The circuit in Figure 1 gives a phase correlation based DCD with "hang" for these TNCs.

How It Works

The DCD circuit presented here is based on the update signals in a digital phase locked loop (DPLL), which recovers both baud clock and data from an NRZI packet data stream. Its output represents detection of baud clock phase correlation with the transitions in the demodulator output data stream.

The circuit consists of the state machine that TNC-2 uses along with some delay elements used to make the DCD decision. The 74HC374 and the 27C64 chip form the state machine. The 74HC14 is used as a pair of retriggerable delay elements, and for signal inversion and buffering. Paul Newland AD7I originally wrote the state machine code used here and in the TNC-2s.

You can get the 27C64 with the state machine code already burned into it directly from TAPR. This same code is in the state machine ROM in any full TNC-2 clone using the XR2211 demodulator and Z80 SIO. If present in the TNC, it will be labeled "STATE 1.09."

One of the state machine signals (which was not used in the TNC-2) appears on pin 19 of the 27C64. This signal is the DPLL update pulse. As long as the DPLL is correctly locked to the incoming data, no pulses appear on this pin. When the DPLL is not locked to an incoming data stream, a continuous stream of pulses appear on it.

This circuit uses the DPLL update signal to retrigger the first delay element so that it never times out when DPLL update pulses are present. If the pulses disappear, the delay element times out and generates the DCD signal.

The output from the first delay element keeps the second delay element triggered so long as DCD is true. When DCD goes false, the second delay element begins a time-out sequence that keeps the DCD output true until the time-out period expires. This is the source of the DCD "hang time."

While the circuit here is mainly intended for 1200 baud VHF FM operation, it also works well for 300 baud HF packet work. If you're on 300 baud HF packet, you'll have to increase the time constant of the "hang" generator (0.47 μF cap) to about 2 μF. The time constant optimum for the DCD generator (the 0.1 μF cap in Figure 1) depends on a number of factors, including the bandwidth of the radio used ahead of the modem.

Pick a value for the DCD generator delay capacitor that produces about a 10 percent duty cycle of false DCD ON time, while monitoring receiver noise on a channel that is *absolutely* free of *any* signals falling within the demodulator's passband. This value will probably be two to four times the 0.1 μF value used for 1200 baud.

Both negative true and positive true DCD outputs are provided so you can use the polarity your TNC requires. Also, JMP1 and JMP2 let you configure the DCD circuit to operate correctly from either a positive or negative true CD output from whichever modem chip your TNC has.

Build the circuit in Figure 1 on as small a piece of perf board as possible. You can then interface it to the TNC and mount it to one of the large chips with double-sided foam sticky tape. Photo A shows the original prototype of this circuit, mounted in a PK-87.

TAPR has a kit available to ease this mod. The kit costs $17.50.(Tucson Amateur Packet Radio P.O. Box 22888, Tucson AZ 85734-22888) Photo B shows an assembled TAPR state machine DCD kit circuit board.

TNC Signals

Once you've built the DCD circuit, you need to obtain some signals from your TNC for the new DCD circuit to use. You'll also have to arrange for the output of this circuit to

be substituted for the normal DCD signal the TNC uses.

DCD circuit operation requires the following signals:

1. A sample of the data the demodulator recovered in the modem.
2. A sample of a clock that has a frequency of either 16 or 32 times the baud rate.
3. The intercepted carrier detect (CD) signal from the modem. This is the CD the modem generated based on amplitude of the input audio.
4. A source of +5 volts. If you use all CMOS parts, current requirements are minimal. The 74HC14 MUST be a CMOS part for the circuit to work properly.
5. Ground. If your TNC has a provision for a TAPR-style modem disconnect header, it can easily locate and conveniently interface these signals (including the X16 or X32 baud clock) at this header. If it doesn't have this header, you'll need to fish around in the circuit of your TNC to find them. In any case, you will have to disconnect the DCD signal currently used in your TNC and reroute it through the new circuit.

Standard Header Signals

The signal locations on the TAPR standard modem disconnect header are as follows:

1. Receive data is obtained from header pin 18.
2. Carrier detect is obtained from header pin 2.
3. Data carrier detect (DCD) is inserted at header pin 1. Jumper from header pin 1 to header pin 2 is removed.
4. The baud clock is obtained from header pin 12. The frequency of this clock will be either 32 or 16 times the baud rate, depending on whether you have a TNC-1 or one of two types of TNC-2. No changes are necessary to use either clock speed.

AM7910 and TCM3105 Connections

The signals of interest on the AMD7910 modem chip are:

1. Receive Data output (RD)—pin 26.
2. Carrier Detect (CD)—pin 25. (This signal is negative true for the 7910 chip.)

The signals of interest on the TCM3105 modem chip are:

1. Receive Data output (RXD)—pin 8.
2. Carrier Detect (CDT)—pin 3. (This signal is positive true for the 3105 chip.)
3. In TNCs that use the TCM3105 chip, but do not provide another source of the baud clock like the Kantronics KAM, you can use the signal at pin 2 of this chip. This signal is very close to 16 times the baud rate (19.11 kHz instead of 19.2 kHz for 1200 baud).

AEA PK-87

It's easy to interface the new DCD circuit to the PK-87. You don't have to switch back to the internal DCD circuit once you install the mod.

The data signal comes from the center pin of JP4, and the carrier detect signal from the end of JP5, which connects to the modem chip. Insert the DCD output signal from the new circuit at the center pin of JP5, and use the *negative true* output. Remove the jumper originally installed at JP5. The DCD indicator on the front panel will show the action of the new DCD circuit.

The X32 baud clock signal comes from pin 13 of U20 (a 74LS393 divider). Don't be tempted to get this signal from the "clock" line on J4, the external modem connector, as this is an X1 clock.

AEA PK-232

This data controller is also easy to interface to the new circuit. The receive data signal is at the center pin of JP4, and the carrier detect signal at the end of JP6, which is NOT connected to pin 3 of the external modem connector. The X32 baud clock signal comes from pin 13 of U8 (also a 74LS393 divider).

Insert the DCD output from the new circuit at the center pin of JP6. Use the *negative true* output. Then remove the jumper originally installed at JP6.

To use the new DCD circuit with a PK-232 on VHF 1200 baud FM:

1. Set the audio level from the radio so that the tuning indicator "spreads" fully on the station with the lowest transmitted audio level on the channel.
2. Set up the DCD threshold control so that the DCD indicator LED on the front panel lights up whenever there is ANY signal or noise input to the TNC from the radio. Be sure that even the station with the lowest amount of audio on the channel lights this LED. This LED should go out when there is no audio input from the radio (dead carrier from repeater, for example).

If you want to see the action of the DCD signal that the new circuit generates, add a high efficiency LED and 1k series resistor between +5 volts and the LED output of the new DCD circuit. The anode end of the LED should go toward +5 volts.

Thanks to AEA, who recently provided for the detection of a DCD fault condition (usually improperly set threshold control) in the PK-232 TNC software. If you have an older PK-232, contact them for the ROM upgrade.

Pac-Comm TINY-2

The Pac-Comm TINY-2 hooks up as follows:

The X16 baud clock signal is at U10, pin 1.
Receive data is at J5, pin 17.
Negative true carrier detect (CDT) is at J5, pin 2.

Note: This is an inverted version of the CD output from the TCM3105 chip itself. Since this is a negative true logic signal, JMP1 on the new DCD circuit will be used instead of JMP2, which would normally be used for a TCM3105.

Negative true DCD from the new circuit is applied to the TNC at J5 pin 1. Remove the connection between J5 pins 2 and 1. The existing DCD indicator LED will not show the action of the new circuit.

If you want to observe the action of the DCD signal that the new circuit generates, add a high efficiency LED and 1k series resistor between +5 volts and the LED output of the new DCD circuit. The anode end of the LED should go toward +5 volts.

If you want to observe the action of the new DCD circuit on the existing LED indicator, you will have to do the interface a bit differently. First, you get the negative true CDT signal from pin 1 of JPD. Then insert the LED output signal from the new circuit at either pin two of JPD or pin two of J5. Remove the jumper currently installed at JPD on the TINY-2 circuit board. Early versions of this unit may not have JPD. If the new circuit is interfaced in this manner, you can no longer use the "RFDCD" signal. (This is no great loss, however, as it will also no longer be necessary.)

Kantronics KAM

The KAM design makes it impractical to correct the behavior of the DCD circuit of the 300 baud modem. For 1200 baud operation, these are signal location points of interest:

The receive data (RXD) signal is at pin 8 of the TCM3105 modem chip.

The X16 baud clock signal is at pin 2 of the TCM3105.

The positive true carrier detect (CDT) signal from the modem is at pin 3 of the TCM3105. This line from the modem to the CPU is labeled with two numbered pads (7 and 8), which represent pin numbers on a 20-pin modem disconnect header physically similar to, but electrically dissimilar to, the standard TAPR modem disconnect header. You should use JMP2 on the new DCE circuit to break the connection between these two locations.

The DCD output from the new circuit is injected at pin 21 of the 63B03 CPU. The front panel LED that normally indicates CDT signal activity will show the action of the new DCD circuit.

Conclusion and Thanks

This article describes desirable characteristics in a TNC's DCD circuit. The modification instructions enable owners of most TNCs to upgrade their units.

I would like to express appreciation to those who helped with this project. Many thanks to Lyle Johnson WA7GXD, who converted the prototype designs to printed circuit boards for the TAPR kits. This will save many people a lot of effort in performing the conversion on their TNCs. My thanks to Mykle Raymond N7JZT, who built the perf board prototype of the state machine DCD circuit. This prototype was used to tune the values of the delay timers. He also volunteered his PK-87 for testing. And thanks to Dan Morrison KV7B, who proofread the article and provided much useful technical advice. ■

Contact Eric Gustafson N7CL at 2018 S. Avenida Planeta, Tucson AZ 85710. *See the follow-up to this article—Improving DCD in XR2211 based TNCs—in an upcoming issue of 73.*

TexNet Packet-Switching Network

An overview of a highly successful and efficient packet radio network.

by Greg Jones WD5IVD

Conceived by Tom McDermott N5EG and Tom Aschenbrenner WB5PUC in the summer of 1985, the Texas network began as a small summer project. One year later, the result was TexNet—an inexpensive, multi-resource, four-port, high-speed "backbone," datagram-based amateur packet switching system. TexNet allows Texas packet radio operators to communicate effectively over distances of several hundred miles in real time, and is currently believed to be the longest and fastest 9600 baud amateur network in the United States (see Figure 1).

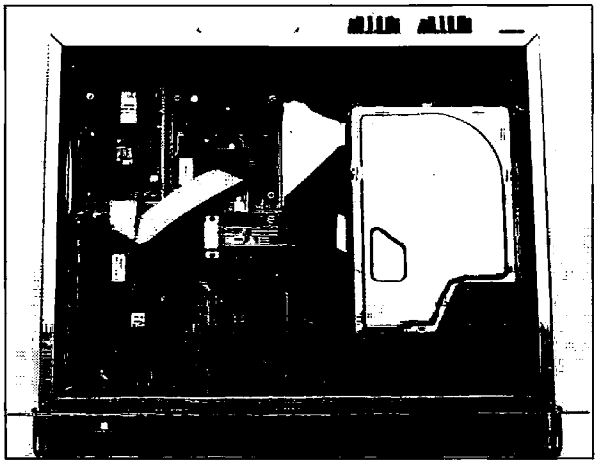


Photo A. Top view...

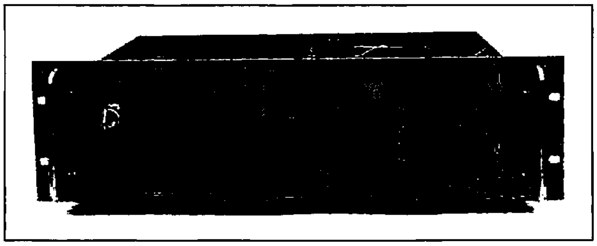


Photo B.... and front panel of a TexNet Network Control Processor. Michigan TexNet Node constructed by Jay Nugent WB8TKL.

System Definition

TexNet, a datagram-based network, acknowledges packets at each step of the path, operates with minimal time delay, and provides user services as well as information about network operations. Operation is at 9600 baud on 450 MHz, with typical local user access at 1200 baud AFSK on two meters or 220 MHz. If necessary, inter-node trunks can run at any of the lower speeds, and the primary or secondary user port will support other baud rates and modulation techniques.

The system is completely compatible with both versions of the AX.25 protocol specifications for user connections. The network itself communicates between its own nodes using AX.25 as the data-link layer two protocol and TEXNET-IP as the layer three network protocol. The TEXNET-IP protocol adds only five bytes of overhead to the front of every packet inside the network.

TEXNET-IP is transparent to all users because the entry and exit nodes translate the users' packets to TEXNET-IP and back again (see Figure 2). The terminating nodes during a user connection maintain tables that specify how each user is connected.

The purpose of an intermediate node is to perform transit-routing only. A TexNet node operates with no fixed routing assignments; a node's routing table is generated upon startup and updated as new nodes begin operations or as current nodes are reset. This allows a node to maintain primary and secondary routing to all other nodes in the network (the user command ROUTE describes this in more detail). TexNet supports 255 nodes per network using the same network ID, and there are 255 network IDs available.

Hardware

The heart of a TexNet node is a partitioned PC board composed of the NCP (node control processor), a 9600 baud TPRS (Texas Packet Radio Society) FSK modem, and a 1200 baud AFSK modem. (Figure 3 shows a block diagram of a TexNet node configuration.) The third port is left free for the attachment of any kind of modem (land-line, 2400 baud, PSK). The 1200 baud AFSK modem is similar to the TAPR TNC-1 modem. The 9600 baud FSK modem is a redesigned K9NG modem, with improved receive filters. The NCP unit contains a Z80A CPU operating at 4 MHz, 32K EPROM, 40K RAM memory, two SIO/0 serial communications ICs for the serial HDLC ports, and a CTC.

Careful design in both software and hardware was necessary to allow all three ports to run at 9600 bps. TPRS decided to develop its own board to keep the cost down and to include two special circuits, a reliable crystal oscillator and a fail-safe state machine called "fire code." Fire code is an EPROM-based logic circuit that monitors the IP data and clock lines (completely independent of the processor and communications ICs) for the presence of a 72-bit unique sequence commanding the node to reset. This 72-bit sequence is programmed into the EPROM along with its state machine. The mean time between false activation is calculated to be considerably more than one million years.

The local console port on the NCP supports the local console, control points, and weather interface. The control points let the node control and monitor status items connected to the node. Some of the uses for control points are to check the status of emergency power at site, to check if the power level of batteries is too low or too high, and to turn devices on and off.

A TexNet daughterboard lets the NCP interface with an optional Winchester hard disk controller. The daughterboard supports the hard disk feature, that in turn supports the packet message server (PMS) and weather feed. The daughterboard also supports additional control points. The local console weather input allows data from the National Weather Service to be fed in at either 1200 bps RS-232 or 75 baud Baudot; this data is then stored on the PMS.

The other key aspect of how well the hardware operates is not the TexNet hardware, but the backbone radio. The performance of

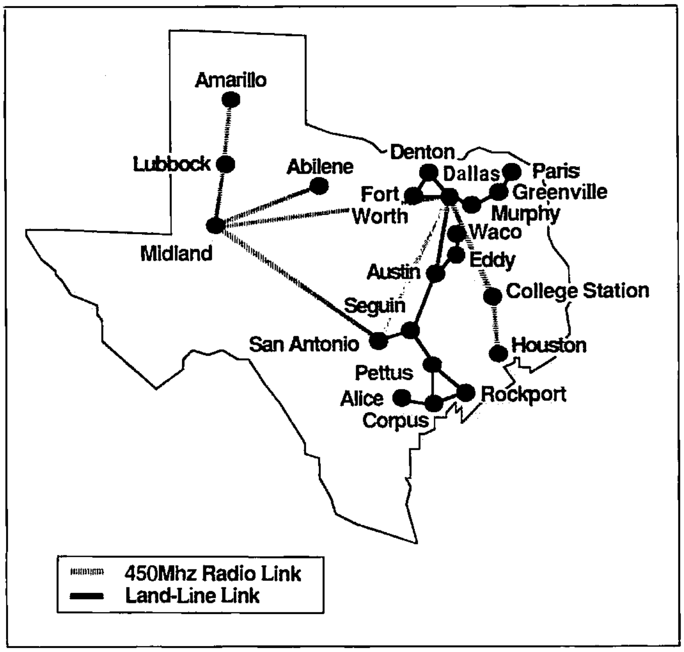


Figure 1. Texas TexNet map.

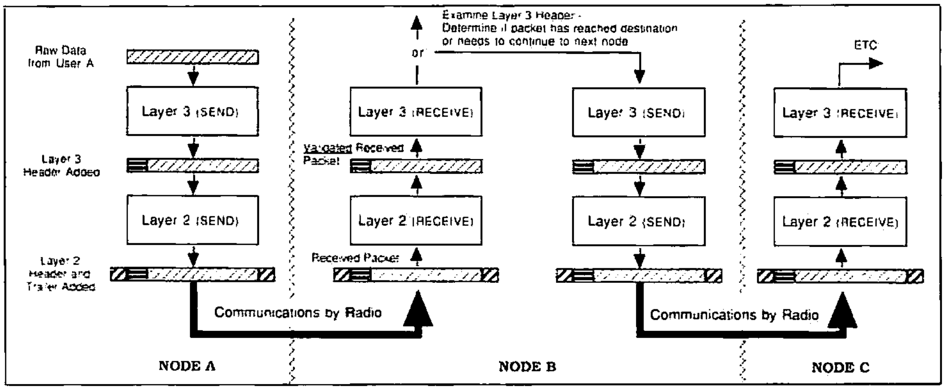


Figure 2. TexNet-IP layering.

the network trunk is critical to the throughput of the entire network. TPRS decided to operate TexNet trunks at 9600 baud, with rapid transmit/receive (T-R) switching. At 9600 baud, packets take relatively little time, and thus make the delay time of the radio between transmit and receive the critical factor. Commercial radios exist that fit this criteria, but they require modifications. The amateur radio community should see continued development of packet radios that will work better for higher speed digital communications, thus making the radio component easier to deal with.

TexNet Software

The most important aspect of TexNet is its software, which provides its services, switching, and user interface. In addition to access to the network, each TexNet node provides several services though secondary station IDs (SSIDs).

•SSID-0: digipeater.
•SSID-2 and 3: conference bridge. Each node maintains two independent conference bridges. Transmitted packets are sent to all other users connected to the conference bridge, providing full protocol protected roundtable communications.
•SSID-4: network access.
•SSID-5: local node console.
•SSID-7: packet message server mailbox, for off system forwarding.
•SSID-8 and 9: crossband digipeating.

Connecting to TexNet (SSID-4) presents you with the simple TexNet network interface, that provides a straightforward way of using the network. All you see is data going in and out of the node. Upon connect, you see:

CMD>***CONNECTED TO WR5C-4
WR5C-4 Virtual Connection 07 at 17:04:57 on 10/1/89
*** Welcome to TexNet V0808-WB5PUC ***
Network CMD ? (Enter H for Help)

At the network prompt, the commands can be typed in completely or their first letter can be used.

User Commands

HELP lists commands. A few typical commands follow: LOCATIONS SERVED CONNECT W5ABC @, LOCATION CONNECT W5ABC VIA W5DEF @ LOCATION, CONNECT CQ @ LOCATION STATISTICS @ LOCATION, STATISTICS YESTERDAY @ LOCATION MESSAGE, and WEATHER BYE.

BYE disconnects you from the network.

LOCATIONS returns a table, listing all nodes on the network by name.

CONNECT makes connections across the network. An example connect command is CONNECT WB5VZL @ AUSTIN. TexNet at that point takes over; the connect request packet is sent to the node named Austin, and that node attempts to connect to WB5VZL.

If the network node, Austin, makes the connection, the originating user sees YOUR CONNECTION IS ESTABLISHED. The receiving station, WB5VZL, will see ***CONNECTED TO WA5LHS-4. (The WB5VZL TNC shows a layer two connection and the callsign of the Austin TexNet node.) Then WB5VZL in Austin will see *** LINKED TO WD5IVD AT NDALLAS VIA TEXNET. At this point, the two users are operating as if in simplex and the network maintains the connection automatically.

If the connection is not made, the originating user will see REMOTE USER NOT RESPONDING. If WB5VZL in Austin were out of range of the network node but could be reached via a digipeater, then the circuit request

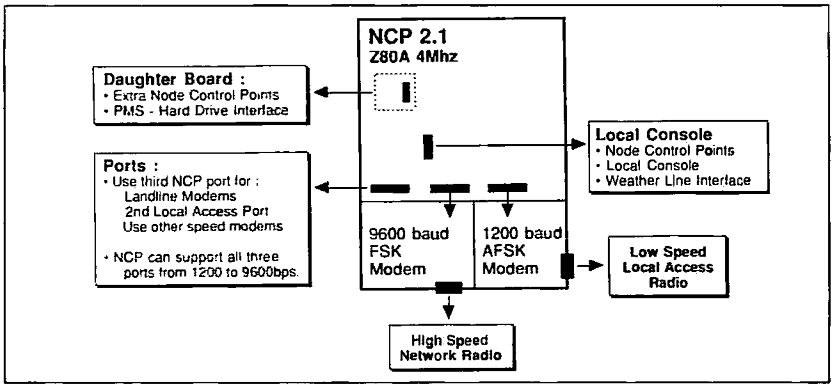


Figure 3. Block diagram of a TexNet node.

string would read C WB5VZL V DIGI @ AUSTIN.

TPRS hopes that a definition and adoption of an inter-network or user-to-network interface standard within the amateur community will soon be agreed upon.

Connections through the secondary user ports are also possible. You can force a connection request through a port other than the primary user port by appending a comma and the physical channel number to the node name. C W5ABC @ NDALLAS,2 would force the connection request through NDALLAS's second user port.

Port zero is defined as the network backbone. Port one is the primary user port, typically 1200 baud on two meters. The user ports can be 1200, 2400, 4800, 9600, or whatever baud the NCP board has been strapped for. Modulation depends on the modem in use. Port two can be an alternate user port or an alternate network trunk.

CONNECT CQ @ NODE is used to broadcast a CQ call over a remote node. C CQ @ AUSTIN, for example, transmits CALLING CQ CQ CQ FROM WD5IVD-0 @ NDALLAS from the Austin node.

The MESSAGE command connects you to the packet message system (PMS) module. The network automatically routes and connects you to the node assigned as the message server resource for that part of the network. The PMS operates as a multi-connect network mailbox, as well as providing emergency real-time transfer and store functions for emergency traffic operations (see the administrative command ALERT).

Once in the PMS system, the command structure is a subset of the W0RLI command set. The PMS is not a full service mailbox/BBS system.

The MESSAGE @ NODE command connects you to a packet message system at the network node indicated. This allows the network to support multiple PMSs at once on the network.

WEATHER connects you to the PMS that is designated as the weather server for the network. The network automatically routes and connects you to the weather node. The weather data is provided through the local console port and is stored on disk. You list the weather products by issuing the LW (list weather) or LS (list server) command at the PMS prompt.

STATISTICS @ NODE returns information about accumulated node activity over a 24 hour period. S Y @ NODE accesses the stats from the previous day.

ROUTE reads a node's routing table and outputs a table outlining the node numbers of all node names in the network, the primary via node, number of nodes on the primary path, secondary via node, number of nodes on the secondary path, and node name for the remote node.

The path's length is weighted with a factor when the network link to the listed node is established. Weighting is done to force the network to a higher speed path if one is available and active. The weight factors are preprogrammed into the node's database.

In the alternate via path column, a node number of 000 indicates no secondary path. Alternate routing allows automatic rerouting of packets past equipment failures or path outages, and has proven to be a valuable feature. You do not need to know the routes, since the network keeps primary and alternate routes hidden. You use the same connect sequence independent of which route is chosen by the network.

Administrative Commands

The UNLOCK command enables and disables the protection on the network's administrative commands. The most sensitive administrative commands cannot be issued to a node by the typical user.

TIME@ NODE sets the real time clock at any TexNet node.

INIT @ NODE does a complete reset of the TexNet node.

A key network function is the ALERT -ON/-OFF @ NODE command. The network alert mode lets the network handle emergency traffic via packet radio. You can enable this mode from any node in the network. When an alert-on is issued at a node, that node sends a "broadcast" command to all other nodes in the network, informing them that alert mode is active at that node. When another user connects to the network, he's informed that an alert is in progress with a command like the following:

WA5LHS-4 VIRTUAL CONNECTION 03 AT 08:30:20 ON 8/1/88 PLS DISCONNECT UNLESS YOUR TRAFFIC IS RELATED TO THE NETWORK ALERT IN PROGRESS FROM AUSTIN.

All network node disconnect timers are disabled. A special mode of PMS is enabled, which provides a real-time message exchange between the multiple users connected to the PMS. Thus, when one user sends to another, all the standard PMS functions are invoked. In addition, after saving the message on disk, PMS checks to see if the addressee is currently connected to the PMS. If so, PMS automatically displays the message at the addressee's terminal.

PMS becomes a real-time message forwarding system amongst its connected users, with the added feature that all messages are archived to the disk. This feature can be extremely useful in emergency communications, since the stations connected to PMS could be physically located anywhere along the network. To re-enable the timers and return the network status to normal, the alert-off command is issued.

POINT ENABLE/DISABLE/STATUS @ NODE allows access to the control points on the NCP. These points can be used to monitor or affect items at the NCP site.

The DELETE NODE command deletes a node from all routing tables throughout the network. This is used in case a route to a node has changed for some reason.

Network Information Messages

There are two areas of node and network operation in which a network condition report or error message can occur. The first level of message reporting is concerned with conditions of the layer two data link—the connections between the two users' TNCs to the network nodes. The second stage is on the layer three network level—between network nodes. Layer three network errors are reported as plain text or as three-digit network information code (NIC). NICs are returned by the node affected or by the next adjacent node attempting connection. Network codes are three digits and are generated by the layer three software.

TexNet Growth

Currently, TexNet networks exist in many states in the United States, and nodes have been shipped around the world. The Oklahoma and Texas networks should be linked together sometime in 1990. TPRS is continuing to work on both TexNet software and hardware development, along with an increasing focus as an organization on general packet education in Texas.

TexNet is not the newest, fastest, or flashiest of technologies, but it is reliable and flexible, and it works amazingly well. For a summer project now in its fourth year, I would say it at least met, if not exceeded, its original design goal.

Greg Jones' specialities are 10 meter packet and CW. He works for Compaq Computer Corp. Greg enjoys mountain climbing and computer hacking. Contact him c/o the Texas Packet Radio Society, P.O. Box 831566, Richardson, TX 75083.

Information

TPRS is interested in spreading its information and research efforts as widely as possible. If you would like more information concerning TPRS or TexNet, please drop a letter to TPRS, PO Box 831566, Richardson, TX 75083.

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Jones, G., B. Wade, and T. Aschenbrenner, "TexNet Administrators Manual 3.5," TPRS, August, 1988.
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73 Review

by Daniel Kautz WB8EHS

DX HELPER–Version 1.3

DX Software for the Apple MacIntosh.

DX HELPER
Randy Stegemeyer W7HR
PO Box 1590
Port Orchard, WA 98366
(206) 871-1111
Price Class: $25

DX Helper is designed to be a comprehensive DX software package. It contains a great deal of information that is presented to the DX operator in a user-friendly Mac environment. It's primarily intended to be used as a real-time "where is the DX" finder, but includes much more than that.

The program Selection Menu offers you these options: Bearing List, Distance List, MUF/Area map, MUF/Area/GL map, and Code Practice. Below this are RESET and QUIT choices. Also available in the next menu window is an Options Menu containing switches (ON/OFF) for Gray Line, WWV (reminder), and Refresh (map display).

Which Way?

Beam heading and distance charts from your exact latitude and longitude (within one tenth of a degree) may be printed out as a chart using the Image Writer. There are two forms of map displays. These are displayed only on the Mac screen as a Great Circle map, centered on your QTH (Figure 1), or rectangular map form (Figure 2). The DX location is highlighted on either map with a large black dot. The GL (Gray Line) and sun (white circle with cross hair) locations are updated every 10 minutes (user option) on the rectangular map display only.

Code practice is a stand-alone extra to the main program.

You can configure the scroll box to the left of the map to several operation modes: a DXCC countries list, an international prefix list, or an Oblast' list (USSR). The only list that works with the maps is the DXCC list. The other two supply information in the box under the map area but do not place a location marker on the map.

If you select DXCC for the scroll box (start up default) and click on a country or prefix, the location is shown on the world map (either polar or rectangular) and the following information is displayed under the map:

•Latitude, longitude and zone.
•Time difference from GMT.
•Bearing and distance from your QTH.
•Time and date information was requested (GMT).
•Sunrise and sunset (GMT).
•3rd party traffic status (yes/no).
•Maximum usable frequency to that location. Good information for the DX hunter!

Another excellent feature is the 24 hour propagation chart (Figure 3) that replaces the rectangular map display when you double click anywhere on the map, or on a country selection. This chart shows you the current time and the MUF (Frequency vs. Time) for the pointer or country location chosen on the DXCC map. The time line runs from midnight to midnight on the X axis. Frequency runs from 0 to 35 MHz on the Y axis. From this you can determine whether conditions are getting better or declining for the part of the world you want to work.

MUF/Area Map Generation

After you click on the menu selection bar for the MUF/Area, the program requests that you enter the upper frequency limit, midpoint frequency, and lower frequency limit, in MHz. In the example (Figure 4), I chose 21.45 MHz (top of 15 meters), 18.0 MHz, and 14.0 MHz (bottom of 20 meters).

The rectangular map is the only display that is used with this function. The program then begins to make 735 calculations for locations spaced evenly over the map display (a grid 35 x 21). This takes about 5 minutes on my computer.

Calculations that fall within the high to mid limits are illustrated as black squares. Calculations that fall between the mid to lower limit are white squares. Any calculations outside the upper and lower limits are not illustrated. Setting the mid limit to the same value as the upper or lower limit can force only black or only white squares to be generated.

There is an option in the menu bar (MUF/Area/GL) for this same display, but it includes the gray line in the map illustration.

The maps or charts shown on the screen cannot be printed. However, the standard Mac system command <control+shift+4> combination will print the entire screen.

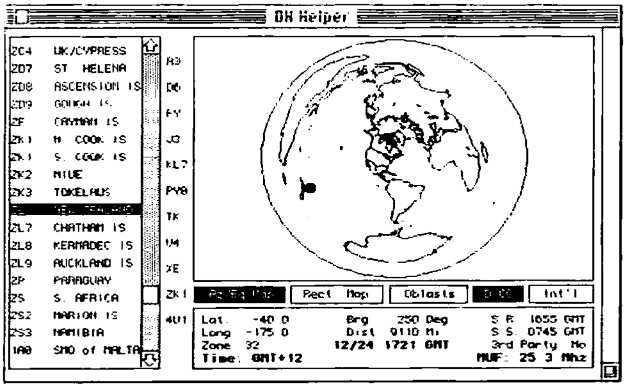
Hone Your CW!

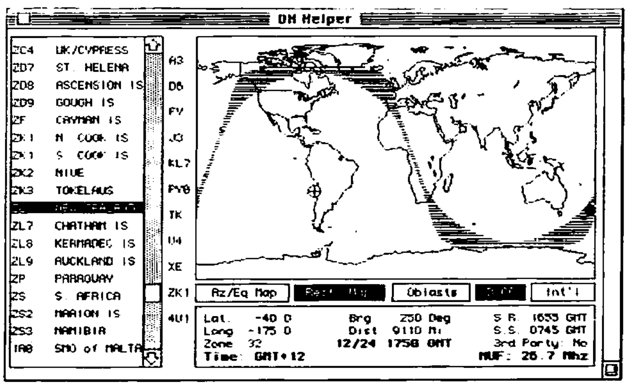
Code practice sends groups of five random characters, with or without punctuation. Speed, pitch, duration (length of time code is sent) and volume are user-selectable. This is a separate program from the DX Helper windows and you must drop out of the main program to use this function.

System Requirements

The program requires a minimum 512K Mac, one 800K double-sided drive, and an optional (required for bearing/ distance printouts only) Image Writer printer. I concur with the manual's statement that anyone with an old 128K Mac should have it upgraded to the new ROM, 512K memory, and 800K drive. My Mac is an original 128K and was upgraded

continued on p. 83





Figures 1, 2. There are two forms of map displays—The Great Circle map, and the rectangular map form.

Amateur Packet Networking

Going beyond just AX.25 . . .

by Brian Lloyd WB6RQN

Amateur packet radio has been growing by leaps and bounds for several years now. The first milestone was the development of the TNC, followed closely by the creation of the BBS. Since that time relatively little changed until the implementation of networking protocols. This article covers some networking concepts, explains where the original popular ham packet protocol, AX.25, falters, and compares and contrasts the more popular networking protocols.

Networking Basics

Most publications attempting to explain network design use the International Standards Organization (ISO) Seven Layer Reference Model. This is why you hear packet gurus talking about the physical layer (layer or level one), the link layer (layer two), the network layer (layer three), and the transport layer (layer four).

Although you may likely envision layers as vertically stacked, like layers of sediment in the earth, the Russian Matriushka doll set analogy is more accurate. The smallest of the set of dolls fits inside the next larger doll, which, in turn, fits inside the next larger doll. Likewise, in the ISO system, the raw packet is first bounded by bit strings that form the protocol for the link layer, which in turn are bounded by bit strings that form the protocol for the network layer, and so on up through the seven layers.

Now, what distinguishes these layers?

ISO Layers

The physical layer is what actually moves data from one place to another. This includes hardware such as radios and modems.

The link layer, such as AX.25 protocol, is responsible for the point-to-point delivery of data. For example, if two packet stations are communicating through a single intermediary, the link layer handles the packet routing from source station to intermediary, and then from intermediary to destination station. The link layer does not look at delivery from source to destination—the transport layer does that job.

The network layer is responsible for routing data through a network to the final destination. For example, say your packet station uses only AX.25, and you want to connect to a station four hops away, with the three intermediaries all being nodes for a given networking system. You first must connect to the first node. Then, from that node, you may issue the connect command for the destination station, or to the next node. Here, the network layer handles your packets from the

Virtual Circuits and Datagrams

Another aspect to consider is whether a given network and transport protocol uses a *virtual circuit* (VC) or a *datagram* type of network. What is the difference between the two, and what are their pros and cons?

In a VC, network packets always follow the same path and always remain in the same order. For this reason, once a VC path has been mapped out, it doesn't need to know about sources and destinations. Only the path identifier (known as a logical channel identifier) is needed to route the packets. A good analogy for the VC approach is the telephone system. In the phone system, you give the address once (by dialing the phone number) and the network establishes the connection. From then on the network routes the signal the same way and does not need to remember the actual source and destination.

In a datagram type of network, every packet must have the source and destination addresses. Every time a packet arrives at a switch or node, the destination address is examined and the switch decides how to route the packet. The analogy for the datagram type of network is the post office. Every packet is like a letter; there is a source and destination address on each one. The letters (packets) are dumped into a mailbox (the network connection) and the post office handles each one separately. If you have too much information to fit into a single letter, you might send it as several letters. Someone on the other must put the arriving letters into the proper order to recreate the original message and request duplicates for any lost letters. This sorting and retransmission request is analogous to the job of the transport layer.

Best of Both Worlds

There's a tradeoff going either way. The VC incurs less "overhead"—routing information attached to each packet—than the datagram method, and so keeps the throughput higher on a healthy circuit, all else being equal. If a part of the circuit breaks, however, VC packets are lost, whereas the datagram system looks for alternate paths to route the packets.

All of the above networking protocols, except KA-Node and ROSE, use the best of both of the above worlds, by running a VC *on top* of a datagram network. KA-Node and ROSE are pure VC systems.

node to which you connected, to the destination.

The transport layer is responsible for the end-to-end delivery of data.

There are three other layers above transport: session, presentation, and application (layers five, six, and seven, respectively). Here, I lump these three together under application, since their discussion goes beyond the scope of this article.

What Layer is AX.25?

Before the advent of networking protocols in amateur packet radio, AX.25 served as both the link and a transport layer (and in fact still does in many stations today). As a link protocol, it ensures delivery of data only between two directly connected stations. There are no intermediate nodes to worry about, so there is no network or transport protocol.

On the other hand, imagine that there are two digipeaters in the path between source and destination. Now we have intermediate nodes (digipeaters) and AX.25 performs end-to-end retransmission on either end. From this point of view, AX.25 is functioning as a transport protocol.

Where AX.25 Falters

AX.25 was never intended to operate as a transport protocol. It doesn't work very well in that capacity—more often than not, communications between two stations fails if there are more than two intervening digipeaters.

Why? The critical point is that, with AX.25 as the transport protocol, any packet lost anywhere between source and destination needs to be *re-sent by the source*.

Assume that the packet delivery probability is 70% between stations (seven out of every 10 packets are delivered without error). This is a common probability. With two stations talking directly to one another this is not a serious problem. With one digipeater in between, the delivery probability drops to 49% (0.7 x 0.7 = 0.49). With two digipeaters in between, there are three hops, and the delivery probability drops to 34% (0.7 x 0.7 x 0.7). Instead of seven out of ten packets being delivered, the ratio has become reversed; only three out of ten packets make it to the destination.

Of course, the originating station retransmits the lost packets, but these must compete with the packets other stations are sending. You see the vicious cycle that occurs here: More and more retries increases the channel loading, which in turn increases the chance of collisions, which leads to further retries. The channel quickly suffers from congestive collapse!

Many avid packeteers soon realized that networking protocols were needed: to use hop-by-hop ACK (acknowledgement of receipt) packets to improve link reliability. (Bear in mind that there is a converse to this—if the delivery probability is very high, it is better to forego the hop-by-hop ACKs in favor of the end-to-end ACKs.)

The network and transport protocols used in amateur packet radio all use AX.25 as a link protocol between points. Some sort of higher level networking protocol is used above/around AX.25 to perform the packet routing function. To date, five networking protocols have risen to regular use in amateur packet radio: KA-Node, ROSE, NET/ROM, TexNet, and TCP/IP. Let's take a look at their strengths and weaknesses.

KA-Node

Kantronics' KA-Node protocol is the simplest of all networking protocols. The user is responsible for manually setting up a network virtual circuit (see sidebar for explanation). To do this, the user connects to the nearest KA-Node and commands that node to connect to the next KA-Node. This process is repeated until the user commands the last KA-Node to connect to the destination. Three intervening KA-Nodes between source and destination require the user to enter four connect commands.

The main advantage of KA-Node is that it uses AX.25 connections between each node to improve the reliability of the end-to-end connection. The other advantage of KA-Node is that it comes as part of all Kantronics TNCs so you don't have to pay extra for it.

"...it is possible to make Net communicate with all (other popular networking systems) and act as a gateway between these different networks."

There are two disadvantages to KA-Node: user complexity, and no end-to-end transport layer. It takes a good deal of typing for a user to set up a KA-Node connection to a remote station. Also, if any intervening connection breaks, the whole end-to-end connection is broken, without the source having any knowledge of what actually got through to the other end.

ROSE

The RATS Open System Environment (a ROSE by any other name) is a full implementation of X.25 and TP1—two common commercial protocols—for a TNC. AX.25 is actually a slight modification of something called Link Access Protocol Balanced (LAPB), the link layer protocol from X.25. Some people within RATS decided that it was a good idea to complete the ISO/OSI protocol stack and implement X.25 and TP1 (transport protocol number 1). The result is a ROM for the TNC-2 that turns it into a real virtual circuit packet switch.

The major advantage of ROSE is that it is available from RATS at little or no cost (the software is available on numerous bulletin boards if you can burn your own ROMs) and it will work with almost any TNC-2 compatible TNC. ROSE also eliminates the KA-Node requirement to send a connect command to each successive node between source and destination. The user connects with the nearest ROSE switch and then tells it to connect to the final destination, using a special country/city code which identifies where the destination can be found. From then on, connection establishment and maintenance is automatic.

ROSE shares the major disadvantage of KA-Node: a disconnect anywhere along the line breaks the entire link to the destination. In spite of this, ROSE is an interesting package that deserves your attention if you have a TNC-2.

NET/ROM

NET/ROM has been around for about two years. The company Software 2000 originally offered it as a plug-in ROM for any TNC-2 compatible TNC.

To use NET/ROM, a user connects to his local NET/ROM, command the local NET/ROM to connect to the NET/ROM nearest the desired destination, then command the remote NET/ROM to connect to the actual destination. All intermediate links use AX.25 to improve reliability.

NET/ROM has some neat features. Every NET/ROM periodically broadcasts all NET/ROM nodes that it knows about. Other NET/ROM nodes hear these broadcasts and forward the information in their own broadcasts. In this way, the information about all the NET/ROM nodes propagates around the network.

NET/ROM works quite well, but it, too, has its limitations. For example, the NET/ROM broadcasts assume that if station A can hear station B's nodes broadcast, then A can route data through B. Unfortunately, this is not always the case, the result being network dead ends.

Another technical problem is that each NET/ROM node must keep a list of all the other NET/ROM nodes in the network. This is fine when the network is relatively small, but it becomes unwieldy when the network gets large. A TNC-2 has only 32K of memory, which is not easily expanded, and the node tables take up precious space.

The last technical problem is that the NET/ROM network layer does not provide for other transport layers besides the standard NET/ROM transport layer. This becomes a problem when you try to do internetwork (connect different kinds of networks).

Finally, NET/ROM is not inexpensive at about $60 per ROM, plus you have to buy NET/ROM all over again to get the upgrades.

Fortunately, there are options that avoid the price. There are other programs that are fully NET/ROM compatible, but are clearly independent of NET/ROM. The first of these is PC/Node, written by John Wiseman G8BPQ.

PC/Node and TCP/IP

PC/Node runs on any IBM-PC compatible computer and provides full NET/ROM capability. PC/Node can make use of TNCs running the KISS (Keep It Super Simple) protocol (most TNCs have this capability), or it can work with an internal packet card, such as the DRSI PC*Packet Adapter or the PacComm PC-100. PC/Node also supports either a WØRLI or a WA7MBL BBS running in the same machine.

The second option is the KA9Q TCP/IP program. KA9Q TCP/IP contains an implementation of the NET/ROM protocol, but it does not include the capability for users to connect with their TNCs. The NET/ROM function of the KA9Q Net program can serve as an intermediary and as a destination node for a NET/ROM network, but not as a termination node for such a network. In other words, Net supports only NET/ROM to NET/ROM packets. Even though it is not a complete implementation, it is quite nice for backbone network nodes where there are no end users.

> ***"The first milestone was the development of the TNC, followed closely by the creation of the BBS."***

TexNet

Unlike the other networking packages described here, TexNet is a complete hardware/software system. A TexNet node includes a Node Control Processor, 9600 baud backbone radios, 1200 baud user access radios, the network software, and a number of application software packages.

TexNet is interesting because, in spite of its simplicity, it works very well. It provides access from user-to-user and user-to-BBS. In addition, many of the TexNet nodes offer weather data and personal messaging.

Technically, TexNet is similar to, but not compatible with, NET/ROM. The Texas Packet Radio Society's choice to offer a complete system keeps the cost down. The TexNet network is a joy to use because it is so fast and reliable.A TexNet node is less expensive than a two-port NET/ROM node, and you get high-speed (9600 bps) backbone trunks in the bargain.

TCP/IP

TCP/IP stands for Transmission Control Protocol/Internet Protocol. Originally developed for the Defense Department TCP/IP is a well-thought-out collection of protocols. TCP/IP was the mainstay networking protocol for government and experimental packet radio long before there was amateur packet radio.

The key to TCP/IP is the Internet Protocol. As the name suggests, IP is designed to interconnect different networks. In the commercial and government world IP is used to interconnect local area networks, dedicated telephone links, public packet switching networks, and packet radio networks. It does this by hiding the differences between the networks.

In amateur packet radio, TCP/IP was written by Phil Karn KA9Q. Phil's "Net" program implements TCP/IP and several associated applications for keyboard QSOs, file transfer, and electronic mail. Net has also been a springboard for others to add functionality to. Net now supports the user information service called Finger, and it supports NET/ROM. Both of these functions were written by others and integrated into the Net package.

One of the problems all the other networking packages have is that they are not compatible with one another. ROSE can't communicate with NET/ROM, NET/ROM can't communicate with TexNet, and TexNet can't communicate with ROSE, etc. On the other hand, it is possible to make Net *communicate with all of them and act as a gateway between these different networks.* Already Net supports TCP/IP over NET/ROM, and there is talk of support for TCP/IP over TexNet and possibly TCP/IP over ROSE. Net is fast becoming the universal packet radio program!

Net is available for IBM-PC compatible computers, the Commodore Amiga, the Atari 520, the Apple Macintosh, and most UNIX™ based computer systems. About the only thing it doesn't run on is the Commodore-64. You can get Net from TAPR for the cost of disk duplication ($1 per disk at last accounting).

Conclusion

Real-live networking is available now. All you have to do is to choose your favorite flavor. All of the networking packages have their advantages and disadvantages. It is my view, however, that the KA9Q Net package stands above the rest because of its universality. It does AX.25 "traditional packet," NET/ROM, and TCP/IP all at once. TexNet is probably the most complete system with everything in one package. NET/ROM and ROSE are interesting because they allow you to turn your existing digipeaters into network nodes with a minimum of fuss. Happy networking! 73

Brian Lloyd WB6RQN has pursued amateur radio enthusiastically since age eight. He recently co-founded Sirius Systems, a networking business in Petersburg, Virginia. You may reach Brian at: 5712 Stillwell Rd., Rockville MD 20851.

DXDA '89
The Dynasty Grows. . .

73 Magazine welcomes the new members to the growing DX Dynasty Award cadre! Special thanks to DXDA chairman Bob Reed WB2DIN for processing the results. Congratulations to all for a job well done.

First One Hundred Award Endorsements

12	WD5N	250 Mixed
19	N6CGB	200 All SSB
43	VE6VK	150 Mixed
50	K8MDU	250 All SSB
68	KF5PE	100 All CW
72	IK8GCS	200 300 All SSB
73	WB4I	150 All SSB

New Awards and Endorsements

101	K5AOB	100 All SSB
102	KW2D	100 All CW
103	PY3ARZ	100 All SSB
104	WB4ETD	100 All SSB
105	N2FPB	100 150 All SSB
106	KD3CQ	100 All SSB
107	K4NNK	100 Mixed
108	VU2DNR	100 All 20m SSB
109	AA5BE	100 All SSB
110	PY5OG	100 Mixed
111	VE4ACF	200 All SSB
112	VE4SI	100 Mixed
113	PJ2KI	100 All SSB
114	WB4CKY	100 All SSB
115	W6EOB	100 Mixed
116	KK4IY	100 All SSB
117	IK1YU	100 150 All SSB
118	N8GCN	100 All 20m SSB
119	KB1AF	100 Mixed
120	KB8BHE	150 Mixed
121	KE2CG	100 150 200 250 All SSB
122	VS6CT	100 All SSB
123	G3IZQ/W1	100 150 All SSB
124	WB6FNI	100 All 80m SSB 150 All SSB
125	KAØIAR	100 All SSB
126	K9SM	100 Mixed
127	W6BCQ	100 150 All SSB
128	KA5MSL	100 Mixed
129	WB4FLB	100 All SSB
130	N7GLT	100 All SSB
131	WAØX	100 All SSB
132	KF4GW	100 All SSB
133	N4QGH	100 All 10m SSB
134	VE1CBK	100 All SSB
135	7J1AAL	100 All SSB
136	K6ICS	100 All SSB
137	NZ7W	100 Mixed
138	WBØN	100 All 20m SSB
139	WC7F	100 Mixed
140	F6IFE	100 150 200 All SSB
141	KL7N	100 Mixed
142	KE8LM	200 All SSB
143	WA6YOO	100 All SSB
144	VE2MFD	100 150 Mixed
145	N3APQ	100 All SSB
146	HK1DBO	100 All CW
147	NM3V	100 All CW
148	IK6GFY	100 Mixed
149	WB6UAN/M	100 All 10m SSB
150	NK6Z	100 All SSB
151	KB6IUA	100 150 Mixed
152	W9OKH	100 All SSB
153	WB5FXT	100 150 All SSB
154	NB3E	100 All SSB
155	N2ESP	100 All SSB
156	YV2EJU	100 150 200 All SSB
157	OZ1DXX	100 All CW
158	IK5IIU	100 150 All SSB
159	KA1ION	100 150 All SSB
160	KD3AI	100 All SSB
161	OK1AEH	100 All CW
162	W9LCR	100 All SSB
163	8P6SH	100 ALL SSB
164	KA6SPQ	100 150 All SSB
165	ZF2KH/ZF8	100 All SSB
166	W6MVV	100 150 All SSB
167	JA8CAQ	100 150 All CW
168	KI6WF	100 150 All SSB
169	K2MRB	100 Mixed
170	AA6GM	100 All CW
171	JAØSU	100 150 Mixed
172	NU8Z	100 All SSB
173	GØGRK	100 All SSB
174	YBØVM	100 All 20m SSB
175	DV1BRM	100 Mixed
176	WØTU	100 Mixed
177	N7CNH	100 All SSB
178	PY3IO	100 All SSB
179	YBØZCA	100 All SSB
180	YBØAF	100 All SSB
181	VE3PQB	100 All CW
182	W2SV	100 150 All SSB
183	N1ADE	100 Mixed
184	WP4AFA	100 150 All 20m SSB
185	KS7V	100 Mixed
186	W2OFB	100 All 20m CW
187	G4ASL	100 All CW
188	N5JUW	100 Mixed
189	KA8WAS	100 All SSB
190	5NØWRE	100 150 200 All SSB
191	AA4IP	100 Mixed
192	JR5KDR	100 All SSB
193	KD2WQ	100 150 All SSB
194	KA3NIL	100 Mixed
195	WA8YWK	100 All CW
196	VE1ACK	100 150 All CW
197	HP2XVB	100 All SSB
198	WB5KYK	100 Mixed
199	N5JUJ	100 150 All SSB
200	N4OBJ	100 All SSB
201	9Q5NW	100 150 Mixed
202	KW2D	100 All 20m CW
203	VE1HA	100 All CW
204	HP8BSZ	100 All SSB
205	IK5JJQ	100 All SSB
206	YC3DKN	100 All 15m SSB
207	I3VKW	100 150 200 All SSB
208	K2EWA	100 All SSB
209	KD3CR	100 150 All SSB
210	N9GDG	100 All SSB
211	KF8K	100 Mixed
212	FD1BEG	100 All SSB
213	DU1DZA	100 All 15m SSB
214	N8IMZ	100 150 All SSB
215	KK4YA	100 All SSB
216	LU1JDL	100 All SSB
217	KA9YYZ	100 All SSB
218	KA4TMJ	100 All 10m SSB
219	WAØDDC	100 Mixed
220	YC1CIS	100 All 15m SSB
221	YC3FNL	100 150 All SSB
222	GØFWG	100 150 All SSB
223	KV4B	100 Mixed
224	N5IET	100 All SSB
225	WA9WIG	100 Mixed
226	N3CDA	100 All SSB
227	KE6KT	100 150 All SSB
228	IK7DBB	100 All SSB
229	JY5EC	100 All SSB
230	N1ETT	100 All 10m SSB
231	PY2DBU	100 Mixed
232	I8IYW	100 All SSB
233	NØISL	100 All 10m SSB
234	KC4BEB	100 All 10m SSB
235	WA7QQI	100 All SSB
236	KA1RJG	100 All 10m SSB
237	OZ9BX	100 150 All CW
238	KB4HBH	100 All SSB
239	KA3RWP	100 All 10m SSB
240	NJ1T	100 150 All 20m CW
241	W4DCG	100 All SSB
242	YCØRX	100 All SSB
243	VE7OJ	100 All 20m SSB
244	AA4W	100 Mixed
245	N9GMM	100 All SSB
246	KB4HBH	100 All SSB
247	KM4HF	100 All SSB
248	CE1YI	250 All SSB
249	KA1FVY	100 All CW
250	N2GVB	100 All 10m SSB
251	N2DAO	100 All 10m SSB
252	WF8E	100 Mixed
253	YBØHZL	150 All SSB
254	N5MBD	100 All SSB
255	N4SNS	100 All SSB
256	KA3TGY	100 All 10m SSB
257	JN3XLY	150 All 15m SSB
258	N4PUV	100 All 10m SSB
259	KA9MRU	150 All SSB
260	KA4OTB	100 All SSB
261	N4JED	100 All SSB
262	AB4KA	100 Mixed
263	WA7OET	100 Mixed
264	KA3RVH	100 All 10m SSB
265	CE7ZK	250 All SSB
266	NI9J	100 Mixed
267	WB9PTN	100 All SSB
268	KB8DAE	200 All 10m SSB
269	WØCL	100 All SSB
270	WB7VUB	100 All 10m SSB
271	JF6TU	100 All 15m CW
272	ZY3IO	100 All SSB
273	KB4VIR	100 All 10m SSB

Official DX Dynasty Countries List: 8/1/89

ABU AIL	A15
AFGHANISTAN	YA
AGALEGA ISLAND	3B6
ALAND ISLANDS	OHØ
ALASKA	KL7
ALBANIA	ZA
ALDABRA ISLAND	S79
ALGERIA	7X
AMERICAN SAMOA	KS6
AMSTERDAM ISLAND	FT-Z
ANDAMAN ISLAND	VU4
ANDORRA	C3
ANGOLA	D2
ANGUILLA	VP2E
ANTARCTICA	KC4
ANTIGUA	V2
ANTIPODES ISLAND	ZL
ARAN ISLAND	EJØ
ARGENTINA	LU
ARMENIA	UG
ARUBA	PJ4
ASCENSION ISLAND	ZD6
AUCKLAND ISLAND	ZL9
AUSTRALIA	VK
AUSTRIA	OE
AVES ISLAND	YVØ
AZERBAIJAN	UD
AZORES ISLANDS	CU2
BAHAMA ISLANDS	C6
BAHRAIN	A9
BAKER ISLAND	KH1
BALEARIC ISLANDS	EA6
BANABA	T33
BANGLADESH	S2
BARBADOS	8P
BEAR ISLAND	JW
BELGUIM	ON
BELIZE	V3
BENIN	TY
BERMUDA	VP9
BHUTAN	A5
BOLIVIA	CP
BONAIRE	PJ9
BONIN	JD1
BOPHUTHATSWANA	H5
BOTSWANA	A2
BOUNTY ISLAND	ZL
BOVET ISLAND	3Y
BRAZIL	PP-PY
BRITISH VIRGIN ISLANDS	VP2V
BRUNEI	V8
BULGARIA	LZ
BURKINA FASO	XT
BURUNDI	9U
BYELORUSSIA	UC
CAMEROON	TJ
CAMPBELL ISLAND	ZL9
CANADA	VE
CANARY ISLANDS	EA8
CAPE VERDE ISLANDS	D4
CAPRI ISLAND	IC
CAYMAN ISLANDS	ZF
CEDROS ISLAND	XF1
CELEBES	YB
CENTRAL AFRICAN REPUBLIC	TL
CENTRAL KIRIBATI	T3
CEUTA AND MELILLA	EA9
CONWAY REEF	3D2
COUNCIL OF EUROPE	TP2
CROZET ISLAND	FT-W
CURACAO	PJ
CYPRUS	5B4
CZECHOSLOVAKIA	OK
DENMARK	OZ
DESECHEO ISLAND	KP5
DESROCHES	VQ9
DIEGO GARCIA	VQ9
DJIBOUTI	J2
DODECANESE ISLANDS	SV5
DOMINICA	J7
DOMINICAN REPUBLIC	HI
EAST CAROLINE ISLANDS	KC6
EAST GERMANY	Y2-Y4
EAST KIRIBATI	T32
EASTER ISLAND	CEØ
ECUADOR	HC
EGYPT	SU
EL SALVADOR	YS
ENGLAND	G
EQUATORIAL GUINEA	3C
ESTONIA	UR
ETHIOPIA	ET
EUROPA ISLAND	FR/E
FALKLAND ISLANDS	VP8
FAROE ISLANDS	OY
FAROUHAR	VQ9
FERNANDO DE NORONHA	PYØF
FIJI ISLANDS	3D2
FINLAND	OH
FRANCE	F
FRANZ-JOSEF LAND	UA1
FRENCH GUIANA	FY
FUTUNA ISLAND	FW
GABON	TR
GALAPAGOS ISLAND	HC8
GAMBIA	C5
GEORGIA	UF
GHANA	9G
GIBRALTAR	ZB2
GLORIOSO ISLAND	FR/G
GOUGH ISLAND	ZD9
GOZO ISLAND	9H4
GRAHAM LAND	VP8
GREECE	SV
GREENLAND	OX
GRENADA	J3
GUADELOUPE	FG
GUAM	KH2
GUANTANAMO BAY	KG4
GUATEMALA	TG
GUERNSEY	GU
GUINEA	3X
GUINEA-BISSAU	J5
GUYANA	8R1
HAITI	HH
HAWAII	KH6
HEARD ISLAND	VKØ
HONDURAS	HR
HONG KONG	VS6
HOWLAND ISLAND	KH1
HUNGARY	HA
ICELAND	TF
IFNI	EA9
INDIA	VU
INDONESIA	YB
IRAN	EP
IRAQ	YI
IRELAND	EI
ISCHIA	IC
ISLE OF MAN	GD
ISRAEL	4X
ITALY	I
IVORY COAST	TU
JAMAICA	6Y
JAN MAYEN ISLAND	JX
JAPAN	JA
JARVIS ISLAND	KH5
JAVA	YB
JERSEY	GJ
JOHNSTON ISLAND	KH3
JORDAN	JY
JUAN DE NOVA ISLAND	FR/J
JUAN FERNANDEZ ISLAND	CEØ
KALININGRAD	UA2
KAMARAN ISLAND	VS9
KAMPUCHEA	XU
KAZAKH	UL
KENYA	5Z
KERGUELEN ISLAND	FT-X
KERMADEC ISLAND	ZL8
KIRGHIZ	UM
KOREA	HL
KURE ISLAND	KH7
KUWAIT	9K
KWAJALEIN	KX6
LABRADOR	VO2
LACCADIVE ISLANDS	VU7
LAMPEDUSA ISLAND	IG
LAOS	XW
LATVIA	UO
LEBANON	OD
LESOTHO	7P
LESSER ANTILLES	PJ
LEVANZO ISLAND	IF9
IBERIA	EL
LIBYA	5A
LIECHTENSTEIN	HBØ
LINE ISLANDS	T32
LITHUANIA	UP
LORD HOWE ISLAND	VK2
LUXEMBOURG	LX
MACAO	XX
MACQUARIE ISLAND	VKØ
MADAGASCAR	5R
MADDALENA ISLAND	IM
MADERA ISLAND	CT3
MALAWI	7O
MALAYSIA	9M2
MALDIVE ISLANDS	8O
MALI	TZ
MALYJ-VYSTOSKIJ (M-V) ISLAND	4J
MALPELO	HKØ
MALTA	9H
MANIHIKI	ZK1
MARCUS ISLAND	JD
MARIANA ISLAND	KH2
MARION ISLAND	ZS2
MARKET REEF	OJØ
MARQUESAS ISLAND	FO8
MARSHALL ISLAND	V73
MARTIM VAS ISLAND	PYØ
MARTINIQUE	FM
MAURITANIA	5T
MAURITIUS ISLAND	3B8
MAYOTTE	FH
MEXICO	XE
MIDWAY ISLAND	KH4
MINAMI TORI SHIMA	JD1
MINERVA REEF	A3
MIQUELON ISLAND	FP
MOLDAVIA	UO
MONACO	3A
MONGOLIA	JT
MONTSERRAT	VP2M
MOROCCO	CN
MOUNT ATHOS	SY
MOZAMBIQUE	C9
MYANMAR (BURMA)	XZ
NAMIBIA	ZS3
NAURU	C2
NAVASSA ISLAND	KP1
NEPAL	9N1
NETHERLANDS	PA
NETHERLANDS ANTILLES	PJ
NEVIS ISLAND	V47
NEW CALEDONIA	FK
NEW HERBRIDES	YJ
NEW ZEALAND	ZL
NEWFOUNDLAND	VO1
NICARAGUA	YN
NICOBAR ISLAND	VU4
NIGER	5U
NIGERIA	5N
NIUE ISLAND	ZK2
NORFOLK ISLAND	VK9N
NORTH KOREA	P5
NORTH YEMEN	4W
NORTHERN IRELAND	GI
NORWAY	LA
OGASAWARA ISLAND	JD1
OKINO TORI SHIMA (BALDWIN'S REEF)	7J
OMAN	A4
PAKISTAN	AP
PALMYRA ISLAND	KH5
PANAMA	HP
PANTELLERIA ISLAND	1H
PAPUA NEW GUINEA	P2
PARACEL ISLANDS	BY
PARAGUAY	ZP
PERU	OA
PETER 1ST ISLAND	3Y
PHILIPPINES	DU
PHOENIX	T32
PITCAIRN ISLAND	VR6
POLAND	SP
PONZIANE ISLAND	IBØ
PORTUGAL	CT
PRINCE EDWARD ISLAND	VE1
PRINCE EDWARD ISLAND	ZS2
PRINCIPE	S9
PRIBILOF	KL7
PROVIDENCIA ISLAND	HKØ
PUERTO RICO	KP4
QATAR	A7
RAPA ISLAND	FO8
REPUBLIC OF CISKEI	S8
REUNION ISLAND	FR
REVILLA GIGEDO ISLAND	XF4
RIO DE ORO	EA9
ROCKALL ISLAND	GM
RODRIGUEZ ISLAND	3B9
ROMANIA	YO
RONACDOR CAY	HKØ
ROTA ISLAND	KHØ
ROTUMA ISLAND	3D2
RUSSIA-SIBERIA	UA9-Ø
RUSSIAN S.F.S.R.	UA
RUSSIAN-URAL MT	UA9-Ø
RWANDA	9X
RYUKYU ISLAND	JR6
SABA ISLAND	PJ
SABAH	9M6
SABAYA	HZ
SABLE ISLAND	VE1
SAIPAN	KHØ
SAKHALIN ISLAND	UA9-Ø
SAN ANDRES ISLAND	HKØ
SAN FELIX ISLAND	CEØX
SAN MARINO	T7
SAO TOME	S9
SARAWAK	9M8
SARDINIA	IS
SAUDIA ARABIA	HZ
SCOTLAND	GM
SENEGAL	6W
SERRANA BANK	HKØ
SEYCHELLES	S79
SICILY	IT9
SIERRA LEONE	9L
SINGAPORE	9V
SINT EUSTATIUS	PJ
SINT MAARTEN ISLAND	PJ
SMOM	1A
SOCIETY ISLAND	FO6
SOCOTRA ISLAND	7O9
SOLOMON ISLANDS	H44
SOMALI REPUBLIC	T5
SOUTH AFRICA	ZS
SOUTH GEORGIA ISLAND	VP8
SOUTH ORKNEY ISLAND	VP8
SOUTH SANDWICH ISLAND	VP8
SOUTH SHETLAND ISLAND	VP8
SOUTH YEMEN	7O
SPAIN	EA
SPRATLY ISLAND	1S
SRI LANKA	4S
ST BRANDON ISLAND	3B7
ST HELENA ISLAND	ZD7
ST KITTS	V44
ST LUCIA	J8
ST MARTIN ISLAND	FS
ST PAUL ISLAND	FT8
ST PETER AND PAUL ROCKS	PYØ
ST PIERRE AND MIQUELON ISLANDS	FP8
ST VINCENT	J8
SUDAN	ST
SUMATRA	YB
SURINAM	PZ
SVALBARD ISLAND	JW
SWAN ISLAND	HRØ
SWAZILAND	3DAØ
SWEDEN	SM
SWITZERLAND	HB
SYRIA	YK
TADZHIK	UJ
TAIWAN	BV
TANZANIA	5H3
TASMANIA	VK7
THAILAND	HS
TINIAN	KHØ
TOGO	5V
TOKELAU	ZM7
TONGA ISLAND	A3
TRANSKEI	S8
TRANSVAAL	T4
TRINIDADE ISLAND	PYØ
TRINIDAD AND TOBAGO	9Y
TRISTAN DA CUNHA	ZD9
TROMELIN ISLAND	FR/T
TUAMOTU ARCHIPELAGO	FO8
TUBUAI	FO8
TUNISIA	3V
TURKEY	TA
TURKMEN	UH
TURKS AND CAICOS ISLANDS	VP5
TUSCAN ARCHIPELAGO	1A
TUTUILA ISLAND	KH8
TUVALU	T2
UGANDA	5X
UKRAINE	UB,UT,UY
UNITED ARAB EMIRATES	A6
UNITED NATIONS-NEW YORK	4U1UN
UNITED NATIONS-GENEVA	4U1TU
UNITED NATIONS-VIENNA	4U1VIC
UNITED STATES	W,K,N,A
URUGUAY	CX
USTICA ISLAND	IE9
UZBEK	UI
VANUATU	YJ
VATICAN CITY	HV
VENEZUELA	YV
VIETNAM	3W
VIRGIN ISLANDS	KP2
WAKE ISLAND	KH9
WALES	GW
WALLIS ISLAND	FW
WALVIS BAY	ZS6
WAYNE GREEN	W2NSD
WEST CAROLINE ISLAND	V63
WEST GERMANY	DL
WEST KIRIBATI	T3
WESTERN SAMOA	5W1
WESTERN SAHARA	SØ
WILLIS ISLAND	VK9Z
WORLD BANK	4U2
YEMEN	4W
YUGOSLAVIA	YU
YUKON	VY1
ZAIRE	9Q
ZAMBIA	9J
ZANZIBAR	5H1
ZIMBABWE	Z21

TCP/IP for the Macintosh

Now this powerful PC runs one of packet radio's hottest networking systems!

by Doug Thom N6OYU and Dewayne Hendricks WA8DZP

There is a new voice in packet radio known as the TCP/IP. TCP/IP can provide hams with many new features and capabilities never before seen in amateur radio packet communication. Implemented on the Macintosh, these features are easy to use and understand.

TCP/IP Protocols

TCP/IP (Transport Control Protocol/Internet Protocol) is a set of protocols developed in the 70s for use with ARPANET, a network of computers used by the Department of Defense. Today tens of thousands of computer systems in the world use TCP/IP because it allows normally incompatible systems to communicate with each other. Typically, TCP/IP is implemented on large mainframe and mini-computers, and has not been available to the personal computer user. Phil Karn KA9Q was challenged several years ago to implement it on his PC. His co-workers said it couldn't be done.... The result was the KA9Q Internet Protocol Package, now available for several major personal computers. Phil's effort has now made it possible for the average ham who has a computer in his shack to use these protocols for packet.

Why TCP/IP?

Packet radio started out before the personal computer really put its mark on John Q. Public. Early use was purely for keyboard-to-keyboard contacts, later evolving into the PBBS (Packet Bulletin Board System) network that exists today.

TCP/IP provides a basic framework onto which you may add services. An example is Telnet protocol, that provides keyboard-to-keyboard communications, just like traditional packet. Another example is FTP (File Transfer Protocol), that implements a simple file transfer system between stations. SMTP (Simple Mail Transfer Protocol) provides mail services. All of these protocols run at the same time, allowing several people to connect to your station at once. As you can see, each of these are separate, and you can easily add new commands as the system evolves. By using the TCP/IP protocols, we now have the ability to interoperate with these tens of thousands of computers on many of the world's networks, not just on packet.

Net/Mac and BM/Mac

One of the major advantages the Macintosh provides is the consistent user interface. This means we don't have to learn lots of new commands to become proficient with any program. However, this requirement to support an "ease of use" interface has caused some difficulties in our attempt to get Phil's package to run on the Macintosh.

One of the major issues we had to overcome was the conversion of NET and BM (the names given to Phil's programs) into Net/Mac and BM/Mac and make them into modeless programs. In the Macintosh world, all programs are modeless. This means that the user can perform any action at any time, regardless of the current state of the program.

For example, Phil's implementation has a command line orientation. A user enters one command after another to cause the program to perform a given set of actions. In Macintosh programs we can perform additional functions, such as opening desk accessories (calculator, alarm clock, editor, etc.) together with cut-and-paste, between programs at any time.

In bringing KA9Q TCP/IP to the Macintosh, we tried to preserve the command line interface while keeping traditional Macintosh functions. This resulted in a hybrid form: one familiar to the typical Macintosh user, while preserving some of the look and feel of the original version.

What It Does

The Mac offers the major advantage of on-screen, multiple-sessions at the same time. Every time the user creates a new session, such as an FTP, a new window is created for that session where all of the input and output will appear. The session most recently created becomes the active session. The user can switch between sessions by either selecting the desired session from the "Window" menu or by clicking on the session window with the mouse.

The console session window is the only session window active when the program is

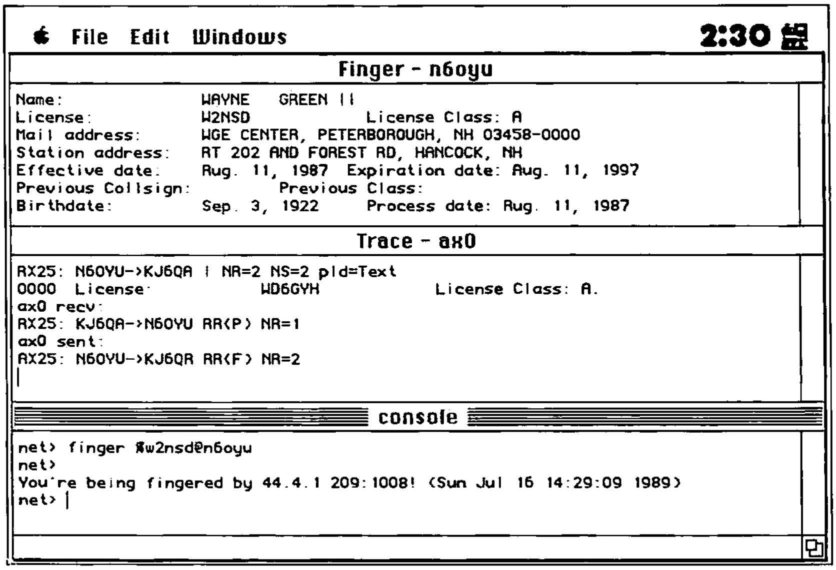


Figure 1. A typical screen with three windows. The top window shows the results of a callsign query, the middle window shows a trace of TNC and computer activity, and the last window is the command console.

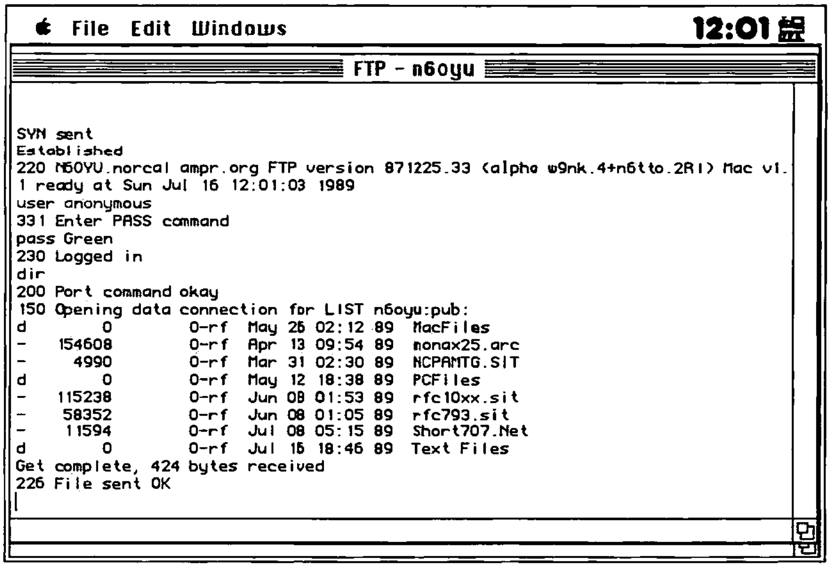


Figure 2. An FTP session with a remote host. The user has logged on to the remote system and requested a listing of the files.

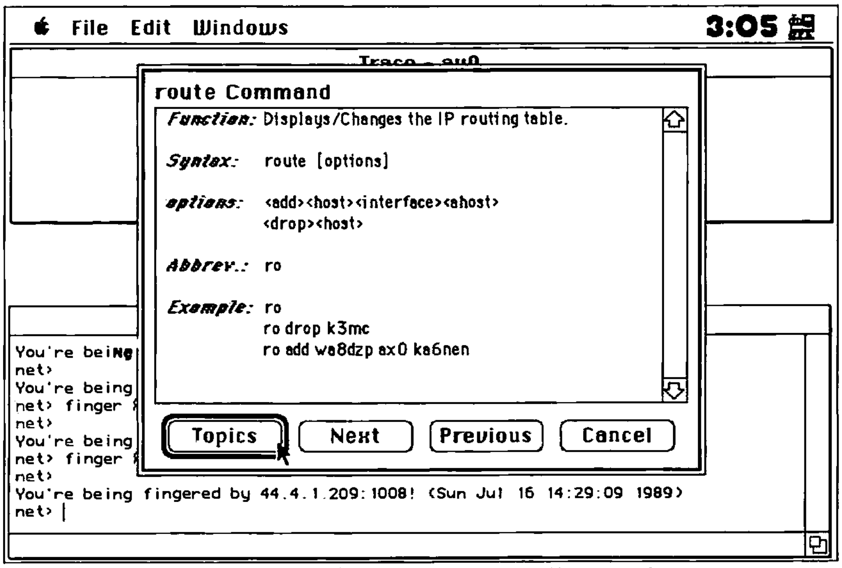


Figure 3. The Help screen for the "route" command.

started. Other sessions are created in the normal manner from commands issued from the console session. The user can create a "Log" session which shows the contents of the system log from the time the program was started. The user can scroll the log to see what traffic the program has handled since it was started. You can start a "Trace" session for any active interface. The session window shows the trace output for the interface as specified by the user.

Finger session windows are handled in a special manner. They are allowed to stay open after the session has closed. The user has access to the information displayed in the window until it is no longer required. In addition, the "Finger," "Log," and "Trace" session windows are treated as read-only. No input is allowed to those sessions.

You can resize all session windows and place them on the screen in any way you desire. You can observe the activity on several sessions at the same time. This feature has proven very useful for normal program operation.

Figure 1 shows a typical screen with three windows. The top window shows the results of a callsign query from a callbook server using the finger command. The middle window shows a trace of all activity between the TNC and the computer, and the last window is the command console window. In this example the console is the active window. Just clicking on another window with the mouse makes a window active.

MultiFinder, the pseudo-multitasking program for the Mac OS, runs Net/Mac and BM/Mac at the same time. You can send and receive documents and mail while answering mail. The only requirement, of course, is lots of memory; 2.5 Megabytes suggested! Net/BM and Net/Mac, running simultaneously on a Macintosh 512Ke, uses up too much memo-

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Vertical Antennas at HF—Part II

More surprising facts about HF verticals.

by Stan Gibilisco W1GV

In Part I in the September 1989 issue of *73*, the aspects of HF verticals I discuss are polarization, ground wave propagation, grounding, use of radials, and calculating antenna efficiency. In Part II of this tutorial, I discuss tuning coils and traps, useful bandwidth, interference, and low-band DX considerations.

Tuning Coils and Traps

My purpose in discussing these is simply to offer suggestions for minimizing the losses they present. The importance of minimizing losses in coils and traps increases as the antenna is made shorter, since the radiation resistance decreases. A coil with 1.5Ω of loss will not seriously degrade the operation of a vertical antenna 70 degrees high, but will devastate the performance of a vertical just 15 degrees high.

Use the heaviest gauge wire for coil winding. Protect the electrical junctions from the elements and they should not, unless unavoidable, be of dissimilar metals (for example, steel and copper). It's best to either weld or solder them. Minimize the total length of wire in the coil by using the smallest possible coil diameter and/or a low-loss powdered-iron core. Make sure the core is rated for the transmit power you want to put into the powdered-iron core.

What's the difference between a coil and a trap? The major difference is that a coil serves only to physically shorten the length of an antenna without changing its electrical length. A trap also has this effect, but it also allows an antenna to operate on more than one band.

In trap construction, the same general rules apply, with the additional constraint that the capacitors have low loss and be capable of withstanding the voltages that will appear across them. Traps should be resonant at the center of each band for which they are designed, or ideally, for the same frequency that represents the median operating frequency in each band used. For example, if you prefer the lower CW parts of the 40 and 20 meter bands, adjust the antenna and traps for about 7.025 and 14.025 MHz; otherwise set them for 7.150 and 14.175 MHz (the centers of the bands).

Useful Bandwidth

The useful bandwidth of any antenna is defined as that frequency range over which the SWR at the feedpoint is at or below certain limits. In practice, a good limit is 3:1, or else that range over which the transmitter can be tuned for optimum operation without the need for an outboard matching network.

A full-size quarter-wave vertical antenna typically has a useful bandwidth of about 5 percent of the resonant frequency. For example, if the resonant frequency is 14.200 MHz, then the useful bandwidth is around 700 kHz—which extends beyond both ends of the band. This value will *increase* with increasing loss resistance, and will *decrease* as the antenna is shortened and inductively tuned. A properly operating short vertical might have a useful bandwidth of only a few kilohertz when the ground plane (radial system) is sufficient for high efficiency. In other words, you can still have an efficient antenna that is electrically short, but the trade-off is narrow bandwidth.

The interesting (and possibly deceptive) point is that a lossy ground system often appears to enhance performance from the standpoint of bandwidth, as well as lowering the SWR if a matching transformer is not used. See the hypothetical case in Figure 8. The SWR-versus-frequency curves are for a 33-foot vertical tuned for 3.800 MHz. The SWR at 100 kHz of either side of resonance, using no matching transformer and assuming a perfect ground system, would be about 7.4:1 (52Ω/7Ω). The bandwidth as previously defined here would be zero unless a transformer were inserted, and this is assumed in Figure 8a.

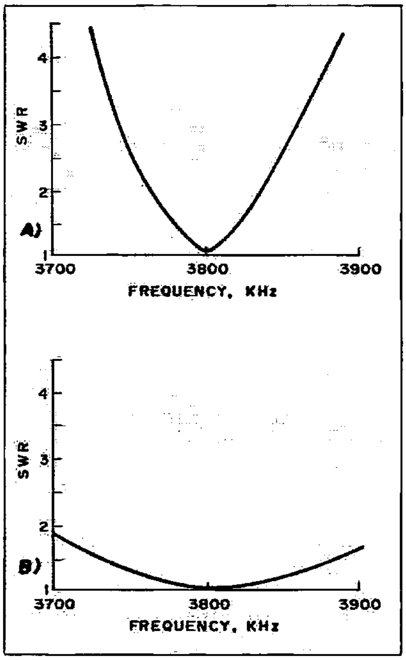

Figure 8. (a) Typical resonant curve for short vertical with inductive tuning, low-loss ground, and matching transformer. At (b) The same antenna without the transformer and with a lossy ground. This graph gives the impression of good performance because of broad-bandedness. Broad-bandedness doesn't always mean high efficiency!

As the loss resistance increases, the minimum SWR becomes lower, and the curve flattens out, giving the impression of broader bandwidth. If the loss resistance were to rise to 45Ω—a quite real possibility with just two or three buried radials—the SWR would be flat at 3.800 MHz, and the curve fairly broad, as in Figure 8b, without the matching transformer. The unfortunate operator would suffer a severely deflated ego if he believed this were a good sign, as the instruments would appear to prove, and then was told, correctly, that:

$$\text{Eff}(\%) = 100(7/52) = 13 \text{ percent}$$

Obtaining Gain

We have seen that you can obtain omnidirectional gain with a half-wave vertical antenna with an extensive ground radial system. The ground plane doesn't increase antenna efficiency (although it may by a few percent, if the ground is very lossy), but it reflects the electromagnetic field, in effect creating a 2-element vertical collinear array. You can add more collinear elements and get more gain; doubling the number of in-phase elements increases the power gain by 3 dB. This is done at VHF and UHF, but seldom at HF because of the practical limitation on antenna height.

Vertical elements may be phased to get gain in some directions at the expense of other directions. Two vertical antennas fed in phase and spaced ½ wavelength apart produce 3 dB gain perpendicular to the line connecting both antenna feedpoints (Figure 9a) and zero signal along that line. If the antennas are fed in opposing phase, such as by adding ½ wavelength of feedline into one of the antennas, this pattern is rotated 90 degrees with maximum signal along the line connecting both antenna feedpoints (Figure 9b).

If both antennas are half-wave in height, and there is an extensive system of radials around each antenna, the gain will be 6 dB over a quarter-wave vertical alone, in the favored directions of the phased vertical system.

Other phasing patterns are possible. One common feed system is to space two verticals ¼ wavelength apart and to feed them in phase quadrature (90 degrees out of phase). The result is a pattern with a null in one direction.

This is called a cardioid pattern since it is heart-shaped. There is some gain in the favored direction of this system, but the lobe is very broad.

A Steerable Vertical Yagi

Another way to obtain directivity and gain is to use one or more parasitic elements. The driven element may be a quarter-wave vertical antenna, and the parasitic elements about 5 percent longer (for a reflector) or shorter (for a director) than the driven element. A 2-element vertical yagi may use either a director or a reflector in conjunction with the driven element. The parasitic elements are not connected to the feedline, but instead are short-circuited to their radial systems (Figure 10).

You may move the parasitic elements by manually changing the positions of the elements, moving them in and out of pre-set holes or rods in the ground. This does not make for quick switching of the antenna's direction, but it may be useful if you don't need this feature. Alternatively, you may make the parasitic elements 5 percent shorter than the driven element, and lengthen them with small inductances in series, thus converting from director to reflector.

Figure 11 shows a switchable bi-directional system. The parasitic element acts as a reflector when the relay is open, and as a director when the relay is closed and the coil is short-circuited. The parasitic element is physically 5 percent shorter than the driven element; with the coil inserted, it is electrically 5 percent longer. The 2 elements are spaced 0.15 wavelength apart. This distance, S, is given by:

$$S_{feet} = 148/f_{MHz}$$
$$S_{meters} = 45.0/f_{MHz}$$

This switchable array gives about 5 dB forward gain over a single quarter-wave vertical. You might put such an antenna to good use on 40 or 80 meters for contest work from the Midwest, for example.

Adding the parasitic element lowers the impedance of the antenna at resonance, which most likely causes an increase in SWR. You may use a matching section or transformer to lower SWR, if desired. You can construct a matching section from a ¼-wave section of 52Ω line (the velocity factor of the line must be taken into account) and the main feedline from 75Ω coaxial cable. Most transmitters will work all right with 75Ω feedlines having reasonably low SWR. If a 75Ω feedline is used, however, do not rely on a 52Ω SWR meter for accurate indication.

The gain and directivity of this antenna will be evident for receiving as well as transmitting.

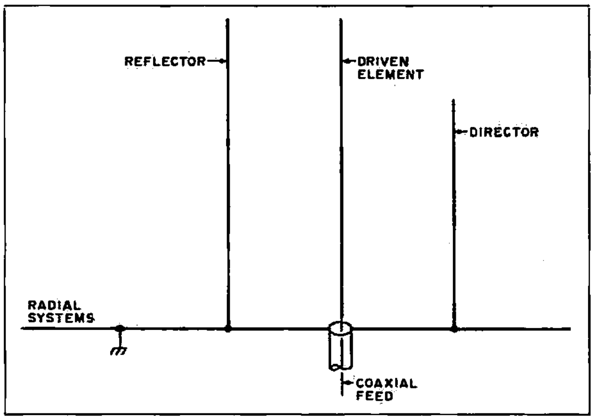

Figure 10. Three-element vertical yagi. The driven element is ¼ wave; the reflector and director are 5 percent longer and shorter, respectively.

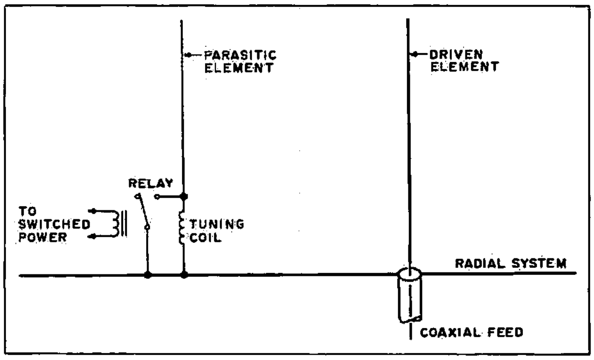

Figure 11. A switchable bi-directional vertical yagi. The parasitic element is physically 5 percent shorter than the driven element, but opening the relay causes the coil to be inserted, lowering the parasitic frequency to that of a reflector.

Verticals and Interference

You often hear that a vertical antenna picks up more manmade interference, especially from appliances such as vacuum cleaners, hair dryers, and electric blankets, than a horizontal antenna. It is true that the vertical component of noise tends to propagate a little further than the horizontal component because the latter is cancelled out by ground plane effects. Nonetheless, you can go a long way to reducing the noise simply by placing the vertical further away from the electrical wires and house. In practice, a vertical antenna may be more likely to pick up interference than a horizontal antenna, simply because the vertical will usually be closer to the sources of interference.

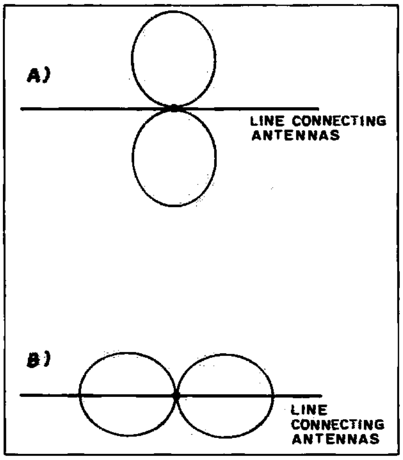

Figure 9. Verticals spaced at ½ wavelength and fed in phase (a) and 180° out of phase (b) produce these directional patterns.

A ground-mounted, backyard vertical antenna is surrounded by houses with their unshielded wiring, and the problem is compounded if utility wires are above ground. In this kind of situation it may be better to mount the antenna up ¼ wavelength and use three or four radials (for each band) that may double as guy wires. Alternatively, you could use a separate receiving antenna, such as a ferrite loopstick with a preamplifier. You can orient this type of antenna to null out the noise.

Vertical antennas may cause more radio-frequency interference (RFI) than horizontal antennas for the same reason; the ground-mounted vertical will usually be closer to home entertainment equipment. Again, the solution is to get the antenna in the clear and well away from home wiring and appliances.

Low-Band DX Considerations

For long-distance communication at frequencies of 7 MHz and below, the vertical antenna is a good choice when space is limited. A dipole antenna must be at least ½ wavelength above the ground to have good low-angle radiation; this will require two supports of that height. But a ¼-wave vertical radiator with a good ground radial system will provide just as much power gain as the dipole, will radiate well at the low angles desirable for DX, and will do it in all directions—with just one support of half the height.

A ½-wavelength vertical without radials will equal the performance of the ¼-wave vertical with radials; adding the radials to the taller antenna will provide 3 dB of power gain at low angles in all directions. Verticals may be phased or combined to form parasitic arrays with directivity and additional gain.

Probably the most visible advantage of a vertical antenna is its unobtrusiveness. Even a quite tall vertical is not an eyesore to most onlookers. You must take care to ensure that the antenna cannot come into contact with utility wires, and some local ordinances forbid manmade structures that will not fall entirely within the owner's property. But for the cost, effort, and space, the vertical antenna may be the best choice for the ham or SWL seriously interested in low-band DX. ■

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ry to run MultiFinder on that system. We recommend at least a Macintosh Plus.

FTP and MacBinary II Support

FTP (File Transport Protocol) provides a method of reliable transfer of files between machines on a network. You can use it to transfer both ASCII and binary files. To make it easier to transfer files between Macintosh systems running NET/Mac, we added the MacBinary II file transfer protocol to the program. Along with the normal data in a file, this program sends all of the Macintosh specific file information (e.g. program specific icons for the desktop). This is necessary as the Macintosh file system is quite different than that of other systems and requires additional information not transferred in an "image" mode FTP transfer.

Figure 2 shows an FTP session with a remote host. In the example, the user logged on to the remote system and requested a listing of available files.

Online Help

Another useful addition is the online Help Facility to both NET/Mac and BM/mac. To call it up, just select Help from the "Apple" menu. The help system documents all the available commands in each program. Figure 3 is an example of the Help screen for the "route" command.

AppleTalk Support

We added a driver for AppleTalk, the local area networking protocol built in to every Macintosh. Here's an example of how we were able to make use of this support. At my QTH, I have a Macintosh Plus connected to a Yaesu FT-211 via an AEA PK-232. However, I do most of this work on a Macintosh II located across the room. Since AppleTalk is a networking protocol, all I have to do was connect the two computers together with a cable, and voilà!: My Mac II now sends and receives files and mail, with no additional radio or TNC. AppleTalk allows me to assign another IP address to my Mac II, and send/receive files and mail via the Mac Plus. In fact, any number of Macintosh's can be connected (up to the limit of 254!) to a single radio/TNC via the AppleTalk network. With additional hardware, I could even connect to the mainframe computer via a telephone line. No additional software is needed.

Operation With Other Packet Systems

The package also interoperates with regular packet services and telephone networks. It supports normal AX.25 connect mode for keyboard-to-keyboard "chats" and PBBS sessions. A mailbox facility is also available similar to other personal mailbox systems in TNCs. It also handles NET/ROM for chat sessions or as a transport mechanism for sending TCP/IP packets through exisiting modes.

Summary

Bringing the KA9Q Internet package to the Macintosh was very rewarding! We will continue improving the user interface to give the packet community an easy to use, "appliance-like" version of TCP/IP.

The code is public-domain and is available from Doug N6OYU for $5 for the disk, which includes postage and handling. You can also download the code from various locations on the Internet. Doug's Internet address is thomapple.com.

We hope our efforts will stimulate more interest in this intriguing new dimension in packet radio!

Doug Thom N6OYU has been at Apple Computer since 1979, and currently serves as a costumer support engineer there. Doug has been active in amateur radio, especially in the digital modes, for four years. Other interests include car racing and scuba diving. He can be reached at 1405 Graywood Drive, San Jose CA 95129-4778.

Dewayne WA8DZP has been licensed since 1961, and is involved solely in packet. He is a free-lance software consultant. Dewayne also enjoys flying his own plane and scuba diving.

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more. Okay, let me repeat a bit of another recent editorial, backed up by the Connections program I saw on PBS. You have to be terribly out of touch not to know that atomic bombs are now portable enough to fit in a suitcase—per the illustration on Connections. So all that's necessary is for one terrorist group to grab enough nuclear material, and guess where they're going to head, suitcase in hand?

Nuclear material comes from atomic power plants, where several recent reports have shown security often is pitiful. Plus we have nuclear sources now in more and more Third World countries. How much trouble would Kaddafi have getting enough for a bomb? The French seem eager to sell atomic energy equipment to virtually any country interested.

So it's more a question of *when* we're going to be faced with a nuclear terrorist than *if*. As I asked in an editorial—how ready is your club? If you're around New York or Washington, you'd better be very ready, with as hardened protection against EMP as possible, with as high-speed automated communications as the state of the art will allow. Depending on Morse Code for communications, where we'll be the only service capable of replacing the telephone, is about as effective as planning to use smoke signals.

Not only are the military almost totally dependent upon telephones, so are virtually all other disaster groups. Civilian Defense officials have almost universally given up even trying to use amateur radio links—too slow, compared to picking up the telephone. Ham communications is slow, seriously prone to errors, and too dependent upon older men without the necessary stamina.

Now, lest I be put down (now, *who* would do that?) for doom and gloom without solutions, the way to resolve this is to first get the FCC to help us find out how to cope with EMP, despite the unreasonable resistance of the DOD. Second, it's time to recognize our need for a million or so active hams, instead of more like the 150,000 we seem to have today. Third, we need to urge the few technically competent hams we have—those who didn't Bash or bribe their way to Extra Class—to start working on high speed automatic digital communications systems—like packet, only much faster. We need to be able to provide million-message throughputs, not dozens, and our gear should be capable of being operated by anyone around who is still alive.

We have the technology to do all this, all we lack is the technicians and the guts to face the biggest challenge of our lives. Lacking this, my suggestion is to move as far away from New York or Washington as you can—and soon! Living near those death traps could be more harmful than smoking, or even Southern California and its coming humdinger earthquake.

The Emperor's Clothes

A few years ago I caused a terrible uproar by proposing that if the code really was as important as was being claimed, then why not have all of us prove every so often that we know the code? Since I knew from surveys that over half of all licensees would fail even the simplest of code tests, I wasn't serious.

Back in 1960, when I started *73 Magazine*, thousands of new hams were coming into the hobby via friends who "gave" them Technician licenses. It was estimated at the time that roughly 75% of all new Techs had no knowledge whatever of the code and only the vaguest interest in theory.

The editor of *CQ* in late 1960 gave Tech licenses to virtually the entire *CQ* staff, none of whom had the slightest technical background or any knowledge of the code. Later he set up a dummy address in Maine and gave them General licenses, still with no tests of any kind. Unfortunately, this activity wasn't unusual for the period.

A few years later, when CB was going strong and more people started getting interested in ham tickets, Dick Bash showed up with a new way around the ham exams. Now, in a weekend of short-term memorization, one could be virtually guaranteed a ticket. Dick would sell you exact copies of the FCC code and written exams and then coach you in how to pass without actually knowing anything. I personally know many Extra Class hams who couldn't pass a General Class code test if their lives depended on it. They Bashed their way to Extra. Some of these are particularly sanctimonious about the code today.

Once the FCC spoiled Bash's game with their VEC tests, the ball was in another court. Now I have no doubt that there are many honest VECs, but I know from my mail and talking with hams at hamfests that there are VECs who view this position more as one of opportunity than of service. The FCC is still trying to sort out how many thousand Extra Class licenses were sold by Puerto Rican VECs. I've recently heard of large scale licenses-for-cash deals in New York, New Jersey, California, Colorado and a few other areas.

Yet, despite what appears to be the widespread buying of ham licenses with no code or written tests, we still have virtually no ham growth—0.8% for the last year.

When you put things in that perspective, it isn't particularly surprising that a high percentage of today's hams would go into complete panic at the slightest suggestion of a re-examination by the FCC. And that's what I ran into when I made the suggestion, even in jest. They had the tar heating up for me in case I attended any hamfests.

When the ARRL proposed to the FCC in 1963 that 90% of the hams be re-examined in order to maintain their voice privileges on the HF bands, the mere proposal of re-examination stopped amateur growth instantly. It so terrorized tens of thousands of hams that they sold their ham stations at fire-sale prices. This, in turn, put 95% of the ham manufacturers and 85% of the dealers out of business within two years.

Incentive Licensing, as the proposal amusingly was called, was a killer. It *was* an incentive of sorts—either you get re-examined by the FCC or you get off the air on voice. That's an incentive, right? Well, it was to the thousands of hams who didn't know the code and believed they'd never be able to learn it.

Sure, a few hams who were given their tickets by friends have taken the time to learn the code and even some theory. One of my 73 editors told me how a friend had forced a ham license on him several years before. Eventually he got interested in repeaters and this encouraged him to start learning theory. He never did learn the code, though he wrote and edited many ham technical books.

So here we are today, arguing about a no-code license, something we've always had. We're talking about offering the no-coders our UHF bands. We manage to forget that Canada has had just such a license available for several years, and so far only about 100 Canadians have bothered to go for it. Sure, let's go the ARRL's proposed route, reinvent an unwanted license, and bet the farm on it.

If you take a look at the Callbook list of licenses you'll find that about 42% are Novice and Technician, and that's no-code. You don't even have to know all of the Morse characters to pass the 5 wpm test, as we showed clearly in a *73* article. Of the 58% with General or higher licenses, what percentage would you say actually passed valid ham exams? By the time we rule out gifts from friends, the Bashers and VEC cash licenses, what have we left? Well, we have the shambles our bands are in today. And we have a widespread lack of technical knowledge. We also have almost completely lost our ability as a group to design or build innovative equipment. I'm having to turn to Japan, Australia, England and Germany to get simple construction project articles for *73*.

Could 20% of today's US amateurs pass a 13 wpm code test? How much would you bet on it? Should we come to grips with this reality and go back to the '50s system where perhaps half of all new hams were fraudulently given their licenses? Should we go back to the last period of ham growth and put Dick Bash back in business selling the word-for-word ham exams and running weekend crash classes? Or should we sell VEC licenses and let them recoup the cost by selling ham exams? The first two systems worked best, the VEC sales haven't managed to provide any significant growth. No, the old license-your-wife, license-your-friends system brought us the most growth. The problem with that system was that it stopped with the Tech license, resulting in almost half the licensees never getting any further, even after 30 years.

What about the golden old days of amateur radio, was it better then? As far as the code was concerned, yes. In the '30s you actually had to be able to copy the code at 13-per to get a ham license. The theory? Well, no. There we had the ARRL License Manual, an almost word-for-word key to the FCC exams. A high percentage of the hams of yesteryear memorized their way to their tickets. Alas, memorization like that lasts for only a few days and is gone—forever. Any college student will verify that for you, in case you've managed to forget that fact of life.

To look at the long term, we've always had a tiny handful of doers and a large contingent of watchers. As a ham publisher over the last 40 years, I've had the privilege of knowing most of the doers personally. When I was a kid on roller skates in Brooklyn in the '30s I visited every active ham I heard on the air. There weren't many hams then, so it wasn't all that difficult. I found that hardly any of them had more than a vague understanding of radio theory, even as simple as it was in those days. I found one ham had built his own receiver, and he was looked upon as a technical wizard by the others.

I did the same as everyone else—I memorized the theory and got my ticket. But it wasn't until I went through the Navy technical schools in 1943 that I actually began to understand the basics of electricity.

I've tried asking some fairly simple technical questions during my talks at ham conventions to see how many in the audience understand them. I'd estimate maybe

2% of the hams understand enough theory to get up and try to teach even a Novice class.

When we were handing out ham tickets on street corners, so to speak, we had 11% annual growth and we found that we were attracting youngsters. 80% of the newcomers were youngsters. We also found that for some reason the hamming experience influenced their lives, since 80% of them went on to high-tech careers.

The Bash system, since it cost money, knocked out most of the kids and brought us older hams, but only about 10% as many as we were getting by giving away licenses. The VEC tickets-for-cash put licenses out of the range for most kids, further driving up the average ham age.

Well, what do you think we ought to do next? Shall we go the ARRL route and relive the Canadian fiasco? Shall we go back to the '30s system and make everyone actually pass a code test? The code was more important then, since 90% of all ham activity was on CW. Phone rigs were just too expensive for most hams.

One of the first ham phone transmitters put on the market (around 1939) was the National 600. It sold new for about $25,000 in today's dollarettes. The flood of war surplus drove ham equipment prices down in the late '40s, so I was able to buy a used "600" in 1947 for a fifth of the original price, one of my better ham investments.

Considering the above perspectives, please let me know if you have any proposals which might tend to get amateur radio some growth.

Those Pesky Minorities

Amateur radio in America, for all its facade of internationalism and pretense of being a world fraternity, has been primarily a closed White community. Oh, it's been open to women, but not on an equal basis. And it's never been congenial for Blacks or Hispanics. It's almost getting time to start thinking about what this means to the future of amateur radio, and even to America.

As one of the few hobbies capable of interesting youngsters in high tech careers, amateur radio has a responsibility to our country—to the world, actually. The projections are that by 2000, one-third of our college students will be Black and Hispanic. Are we going to make sure that few of these kids go into technical colleges by continuing to freeze them out of amateur radio? The end result will be even fewer American engineers, technicians and scientists. And that means a guaranteed lower national income as technology blossoms in Asia and Europe, leaving us further and further behind.

I mentioned in a recent editorial how few minorities we have in our hobby. I rarely see a Black at a hamfest. Some of our Puerto Rican hams come to Dayton, but that's about it. How many Hispanic hams do you see at the big Dallas hamfest every year? How many at Miami?

If America was able to keep up with the rest of the world in technology while keeping women and minorities out of amateur radio, we could just excuse what we're doing as another manifestation of good old American red-neckism. We're a bunch of good ol' boys and we're going to keep out the riff-raff.

Women belong in the ham club auxiliary. We need 'em to bring the coffee and doughnuts. They're too dumb to be able to understand a technical talk, right? Well, that's what I see as an almost universal American ham attitude. And, unfortunately, women seem to go along with this without a whimper.

Oh, there are a few belligerent women who attack every imagined slight to women, usually doing more harm than good. Women's Libbers has gotten to be an epithet. Being nasty as a way of breaking stereotypes doesn't help much. What we need are more shining examples.

I know there are some fantastic women in amateur radio. Every now and then I meet one at a hamfest or a club meeting where I'm talking. Some clubs are even proud to have such a woman. But let me ask you this, when's the last time you read an article in a ham magazine about a woman ham who has accomplished anything significant? Come on, fellas, let's put some light in the darkness—let's see some promotion of your good examples. And that holds for women and all of our minorities.

Martin Jue (MFJ) visited us with his chief engineer, Steve. Steve Pau KF5C is an Extra Class ham and comes from Malaysia—Sabah, to be exact. Sabah 9M6 is a beautiful country, one you should make an effort to visit. You aren't going to find a more friendly country. We've had quite an influx of Asians in recent years. You've read about how their children are running circles around American children in school, mainly because their parents have been pushing them to be well educated, while ours have been busy watching Lucy reruns, Johnny and Oprah.

Over half of the American college graduates today are foreign students, and that holds for our technical colleges, too. This wouldn't be so bad if this meant we had to build more colleges, but the problem is that our colleges are failing right and left. Several have failed around my area just in the last year! So we have fewer and fewer colleges and more and more foreign students in the ones we have. It's almost enough to make a person think. Even a ham. Could we be doing something wrong?

A recent letter from an old ham friend was critical of the League for not having any minorities on its board of directors. No Blacks. No Hispanics. And only one woman! Tsk. No, I'm not going to trash the League because they so accurately represent our hobby in this respect—represent the actuality, not the utopia.

Heck, until fairly recently it was impossible for a Jew to get on the board. I remember when the first Jew was elected and was referred to as a Hymie by the other board members. That was only about twenty years ago. Now there are four Jewish directors.

Okay, I've laid out a problem for you. We're doing amateur radio and our country a disservice by excluding minorities. What can we do to change this? Sure, I could tell you what I think, but it's time for you to do some thinking, some problem solving. You tell me. Write to me. Fax me. Send me ARRL messages. What do you propose?

One way to solve a problem is to look for some place in the world where that same problem, or a similar one, has been solved successfully. This has been my approach to coming up with solutions to such miseries as welfare. I looked for a parallel situation where a group of people were desperately poor and needed to start a whole new life. I found a fine example of this in another country, an example which I think could be transplanted to America quite successfully and break the whole welfare system apart. The money we'd save just by solving this mess would largely cure the deficit—at least until Congress could cook up some other ways to spend the saved money.

So—what do you suggest? Do you know of any ham clubs who have welcomed Blacks or Hispanics? I don't remember seeing any pictures of such a club crossing my desk—despite my repeated requests for same. Lacking any communications to the contrary, it's easy to assume that few, if any, ham clubs are even modestly integrated.

With more and more Americans being minorities, we're painting our hobby into a smaller and smaller corner by ruling these groups out as candidates. Tell me again how you don't agree with me 100%—and then tell me why.

Still More Grousing

We're in a technological age, and that means communications, and that means frequencies. Not only are we well into a technological age, it's only going to get more high tech. Just look at the changes in the last few years—telephones so complicated we have to be retrained to use them after every coffee break. Fax in almost every office, spewing out letters and reports all day long. We have to cope with computer bulletin boards, data networks like CompuServe, police radar and cellular radio.

Satellite dishes in back of a million homes. Cable TV bringing in 100 channels of garbage—garbage which the average youngster is watching 5½ hours a day, by the way. The average family is watching 11½ hours a day! Is it any wonder so few know how to read, are able to find the US on a map, or know who won the Civil War? Or that only 7% of high school graduates can even hope to be able to cope with a technical college?

Parents, with the TV on all day, no longer have an opportunity to talk with their kids, so they get almost zero of what we used to call family education. Kids aren't encouraged and helped in their school work by parents, other than Asian immigrant parents. They aren't being taught values, goals, how to cope with growing up, how to cope with drugs such as alcohol, nicotine, pot, uppers, downers and so on.

Is it any wonder in this age of kids left to drift—kids who are being graduated from high school with so little education that many can't read—that something as complex as amateur radio, a technical hobby, seems an impossible goal?

As I see it, we have a choice; we can maintain our high standards. . . and lose amateur radio, or we can try to change the country, to educate parents and get them to turn off their TV sets for a few hours a week. Like any other bad habit, not talking with one's kids comes about as a result. No one means to neglect their kids, but it's just easier right now to watch the Today Show, the evening news, Tonight. So we put off talking with the kids until tomorrow, and tomorrow. This, faster than you think, turns into years and one day you notice you've got a big problem. By then it's too late to establish a rapport, so you're stuck with the mess you've made of your kid's life.

Some parents almost wake up to what's happened when they go to their kid's funeral—drunk driving, or another crack death. Others are more fortunate and only have a teenage pregnancy problem, which quickly converts them to the pro-choice religion. The obvious response is to get mad at the

kids, not ourselves. After all, we meant well. It's just that we were too busy.

Your kids into heavy metal? Probably, unless you've spent some time introducing them to classical music. We're into the largest move into classical music in history, courtesy of the compact disc. Millions of people in their 30s who used to buy rock LPs are now buying classical CDs. Indeed, I've published a guide to classical music which has been immensely popular. That's all fine for getting kids interested in better music, but it still doesn't give parents any more time to talk with their kids. And that means our job of attracting youngsters to amateur radio isn't any easier.

If we're going to have a prayer of holding frequencies, we've got to use them, and that means we need more hams. The reason we haven't used 220 is that we haven't really needed it for anything. 2m has more than enough room in 99% of the country—room to spare—and if we didn't have a tacit agreement that every ham has a right to his own repeater channel, we'd have no problem even in Southern California. 95% of the repeaters there are unused 95% of the time—just like everywhere else. A small group of repeaters handle most of the action.

450 in So. Cal is "full"—why? Private, protected frequencies for every repeater link, repeater and remote base, that's why. The actual use is pitiful. Virtually every link on 450 could be moved to 10 GHz and all put on one freq with directional dish antennas, and with no interference. Instead we have repeater wars and mounting legal battles over who has the right to coordinate these almost totally wasted channels. Quick, graduate more lawyers.

We have 500 MHz going 100% to waste on 10 GHz. Some 99.96% of our total frequency allocations are totally unused. If you were an FCC commissioner, what would be your reaction to this? Here we have what is obviously a dying hobby, something used 99.99% to entertain a dwindling group of crotchety old men who are using about 0.04% of a desperately needed national resource.

We've got high definition TV, improved mobile and personal communications—probably via satellites in the wings—as fast as the Japanese can perfect the new systems for us.

Yes, there was a time when the hobby was needed as a resource for the country. It was a way to get youngsters interested in electronics so they would self-educate themselves and thus be of value in case of war. Today few hams go beyond memorizing the expected questions and writing down the answers. The rest just pay off a VEC and walk away clean. The military would have to start from zero to train 99% of today's young hams—either of them.

When we went into WWII we had about 50,000 licensed amateurs. 80% of those, 40,000, went into the military and were of enormous value. I joined the Navy and found my teachers in the Navy electronics schools were, almost without exception, hams. The schools, by the way, were superb.

WWII was largely won by our development of radar. It was certainly shortened enormously. I know because I was there using it. I was able to guide my submarine, *The USS Drum, SS-228,* right through the middle of Japanese troop convoys on the surface in the middle of the night, keeping track of every troop ship for aiming our torpedoes and every escort for avoidance. They hadn't a clue just where we were as we sunk ships right and left.

One could make a very good case that our amateurs contributed most significantly to the winning of that war.

That's in the past. I doubt if one ham youngster in a hundred (if there are a hundred) would be of much value to today's military. Amateur radio is so far behind both military and commercial communications and electronics that hams today would have to start from zero. We're still sending messages by hand key at around 10 wpm while the world is zipping along at 56K—and speeding up.

The tech age is here—commercially. We hams are still radio relaying with hand keys, sending hey, how are you messages by the hundreds. I got a nice birthday message via the Relay League traffic network, sent two days before my birthday and delivered ten days after; came from Connecticut. Great message handling system for 1989, eh?

In the meanwhile the Japanese are working on voice compression systems which digitally compress the voice down to an effective five hertz bandwidth. The RIAA fuss over DAT tape may have reached your consciousness. A DAT tape will hold two hours of extraordinary hi-fi digital sound. If we digitize the phonemes, we can store 18 months of voice on the same tape. Do we have the potential for setting up voice channels every 10 Hz on 20m—that's 100 per kHz—35,000 channels? We have about 150,000 active hams, so that's about five per channel. We can live with crowding like that.

Is it time yet to speed up our packet system from the present casual 1.2K to 56K? This is pretty standard for commercial work—that's about three thousand words per second. If you can read 300 words per minute, you'd be able to keep up with your reading ability by sending 1/10 second messages every minute. This would allow up to 600 QSOs on every channel. Of course, we can only type at around 30 words per minute, so we'd be badly input bound. We'd type for ten minutes, send it in 1/10th second—read it for a minute—and so on. Ho hum.

Perhaps, like SSTV, we'll start putting our stuff on disk or tape and sending previously written (archive) material. That'll make us work more like a newspaper, spending most of our time writing things to send. I ran into this problem with RTTY back in 1948, forty years ago. We used punched tape then, but we found we had to paste together rolls of it and feed it through the reader to keep up with our printers. 60 words per minute calls for very fast typing, but is slow reading. So I'd keep rolls of tape with punched stuff I'd previously written at hand and feed it into my tape reader while I was punching my answers to the last transmission. When my prepared tapes were sent, I'd rip off my new tape and feed it through. It was hectic, but fun.

Unfortunately, after a couple of contacts with someone to whom I'd sent all my material—now what? It's exasperating to sit there and watch your page while a hunt and peck typist finds each letter on his keyboard and sends it at more like ten words per minute than 60. You sure can get all over your RTTY enthusiasm fast after a few of these turkeys.

The RTTY data burnout problem is very similar to that with SSTV. Watching the same old slides over and over from the chap you've contacted is a killer. Hey, I've already seen your shack, your XYL and the harmonics. Yes, I've seen your dog. Now what? 73, right?

Well, if I ever get the time to get on RTTY, I'm loaded now. I've got around 70 computer disks packed with materials I've written. Heh, heh! With only a little editing, I can take my articles, editorials and letters and have them ready to keep someone reading for a week after a five minute contact. Well, I could if we'd get our speeds up. At 1200 baud I'd be sending for a week. Heck, it's all automatic, so why not? No, I'd never get any second contacts with anyone, but the first would sure be a zinger! I could run through a whole box of paper for them. Get your hard disks ready, I've got about 30 MB ready to dump on you.

Which brings me back to our need to get amateur radio growing—with kids. We need it to keep from losing our hobby. America needs it to keep from losing even more technology to Japan. Our kids need it if they're going to be able to cope with the world of 2000. We're talking technology at every turn—communications, numerical control of machinery, automation and robots, computers on almost every desk in offices and doing the nitty gritty work for most businesses.

If we're going to attract kids we've got to come to grips with the fact that what we're doing now has failed—totally. We're down about 54% in newcomers into amateur radio in the last four years, rapidly heading toward extinction.

Yes, if we could get parents to get their heads out of the family TV set and start giving their kids some help, some encouragement, get them excited about learning instead of being saturated with TV, heavy metal rock and the almost inevitable (now) experimentation with increasingly lethal drugs, so what else is there to do? We might be able to con today's kids into learning the code the way we had to fifty years ago—before TV. Until you figure some way to retrain parents, we either have to change our ideas and come to grips with the real world, or we're out of here.

I do have some hopes of bringing about a major change in our educational system, with an eight-year course in the fundamentals of electronics, one which goes to lengths to get kids interested in hamming. But that's not going to happen next week.

Incentive licensing destroyed the whole infrastructure of school radio clubs which brought us 80% of our hams. The sooner you can get your local schools to work with your ham club to get new radio clubs started, the sooner we'll start at least having a chance at rebuilding our hobby. In the meanwhile, either we find a way to sell the product or we're out of business.

Oops, There Goes Six!

It's beginning to look like a feeding frenzy as commercial interests, their juices up over the ease with which the FCC lopped off 40% of our 220 band for UPS, are going after more ham bands.

There's an announcement in *Broadcasting* magazine (tnx WA4ZID) that Lawrence Tighe K2JIA, who owns WRNJ in Hackettstown, New Jersey, has proposed that the 50-54 MHz ham band be made a new FM broadcast band. Thanks, Larry.

HF Packet Tuning Aid

Spot-on tuning every time!

by John Reed W6IOJ

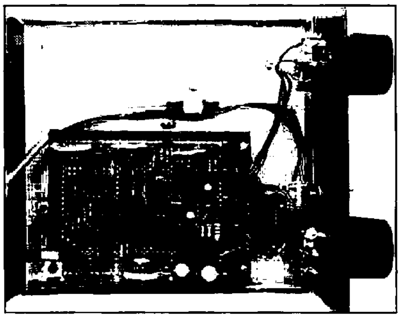


Photo A. Component layout on the HF packet tuning aid board.

The avid HF packeteer eventually develops a sixth sense for correct tuning on these bands. Most newcomers, however, have trouble tuning properly even using a commercial tuning indicator. Such was the case with me and my AEA PK-64 with the HFM-64 bargraph tuning indicator. This isn't surprising, as the setting is critical; for HF packet you have to tune to within 10–20 Hz of the center frequency.

Use Your Ears

An off-frequency station on an HF packet channel sounds distinctly different from properly-tuned stations. With this in mind, I developed a packet signal synthesizer that contains the proper frequency components to use as a tuning aid.

This project began with this general idea, and the resulting device is very effective. Tuning is a snap, and you can optimize it within the needed Hertz. The circuit is simple, and you can buy every part, even the pre-drilled/solder-ring circuit board, at Radio Shack.

How It Works

Refer to the block diagram in Figure 1. A square-wave timer provides the space tone (typically 2,310 Hz), and a diode switch makes the necessary 200 Hz frequency shift keying for the mark tone. A second square-wave timer keys the switch at 35 Hz to simulate packet keying. This is followed by an active filter with a response centered between the space and mark frequencies. The filtered output combines with the radio output for the audible comparison. The assembly includes controls to adjust the radio output amplitude and the level of the synthesized packet signal to the phones or speaker.

For CW applications, the 35 Hz tone switches off to leave only the space frequency, which is also the PK-64 Morse filter frequency. Zero-beating the radio CW signal to the filter frequency gives you much improved automatic Morse decoding.

Circuit Details

See the schematic in Figure 2. One section of a 556 IC dual timer makes the space/mark square wave. C1, R1, and R2 make up the related space frequency time constant, with R2, the 10kΩ potentiometer, providing frequency trim. R1 is the value used to get 2,310 Hz, the HFM-64 space frequency. You can change this resistor for other space frequencies. For example, add 10k for 1,800 Hz.

Switching in C2 makes the lower mark frequency, the series 50kΩ R3 potentiometer changing the reactance enough for the fine trim. The C2 value is for the HFM-64 2110 Hz mark tone. Change C2 for other mark frequencies. For example, add another 470 pF capacitor for 1,600 Hz (assuming 1,800 Hz space tone). Two 1N914 diodes switch C2. Biased off for the space tone, they are switched on for the mark tone by switching transistor Q1.

The 556 IC second section makes the square wave used to switch between the space and mark tones, the 1-MΩ time constant potentiometer R4 providing a range of a few cycles to several hundred. Experimentally selected, the 35 Hz keying rate sounded most like the nominal packet signal. The PK-64

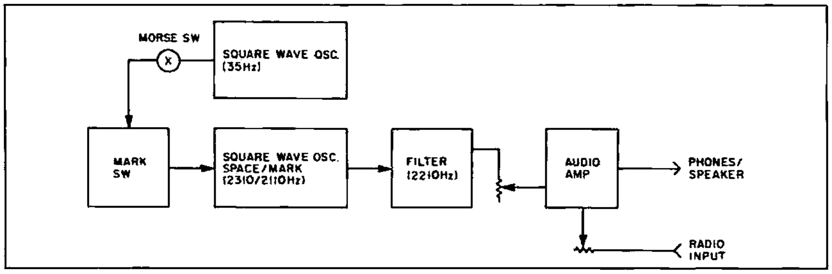


Fig. 1. Block diagram of the HF packet tuning aid.

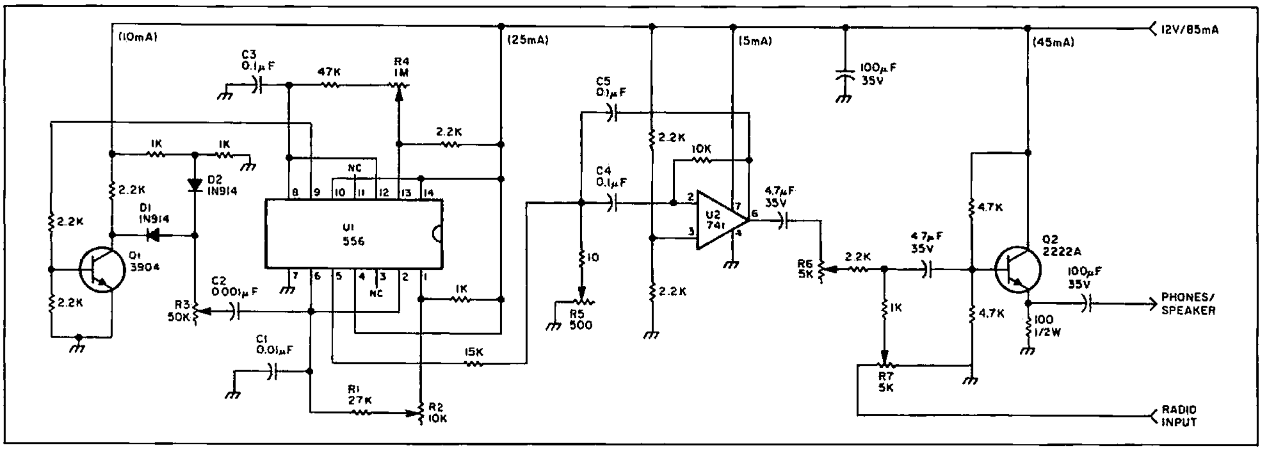


Fig. 2. Schematic diagram of the HF packet tuning aid.

Morse function is accomplished with a mechanical switch that disables the modulation, leaving only the space tone.

A typical active op-amp filters the timer square-wave output, and R5 allows you to adjust the peak response frequency. The 500Ω potentiometer is the lowest Radio Shack stock value; a 100Ω value is more appropriate. The filter output and the radio signal combine to drive the output audio amplifier through level control potentiometers and series resistors. This resistive network prevents the tuning aid signals from feeding back into the data controller.

Alignment

For this, you need an accurate space/mark frequency reference. It's ideal to use a signal generator with a frequency counter. You can, however, also get signals from the data controller. The PK-64 has a software calibrate mode by which you can transmit both space and mark frequencies over the mike output lead. A counter permits reading the frequencies directly off the screen. A third, less accurate method, derives the tones from a CW signal on the radio. This assumes your radio has a digital readout accuracy of 50 Hz or better.

Calibrate the space tone by placing the Morse switch in the open position to leave only the single tone, and then connecting the reference tone to the radio input. You then compare the two combined audible tones, using the phones or speaker and adjusting the trim potentiometer R1 to zero-beat the tones. To switch to the mark tone, turn Q1 on temporarily, with a 500Ω resistor connected between the 12 V supply and the open Morse switch (2.2kΩ junction). Mark reference comparison is made by adjusting R3 for zero-beat of the tones.

Op amp frequency adjustment is best made with an oscilloscope. Adjust R5 to equalize the space and mark tone amplitudes. Switching transients should be barely perceptible.

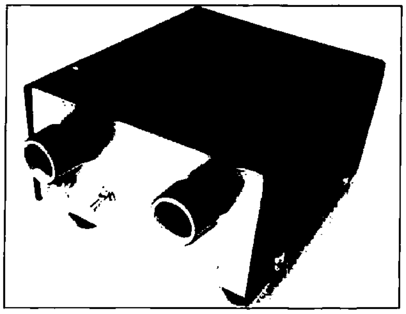


Photo B. Front panel of the tuning aid.

An oscilloscope, however, isn't essential. You can make a fair adjustment by first turning R4 for minimum switching frequency (3–4 Hz), and then adjusting R5 for equal audible space/mark tones.

The switching frequency is not particularly critical. You can increase the frequency by adjusting R4 until the sound is definitely less like that of the nominal packet signal, and then lower the frequency a bit.

Easy To Use

Just tune the HF rig to a packet signal. If, when you turn up the synthesized signal, you get a tone pair similar to the received packet signal, you know you're dead-on! In just a few moments, that long-distance packet text will start scrolling across your monitor. . . 73

John W6IOJ, a ham since 1933, has contributed to amateur publications since 1941. His career in R&D included radar development at MIT during WWII. John holds 10 patents and has written many construction articles on UHF transmitters. Since his retirement, his hobbies include abstract painting. For more info on his article, please write to John at 770 La Buena Tierra, Santa Barbara CA 93111.

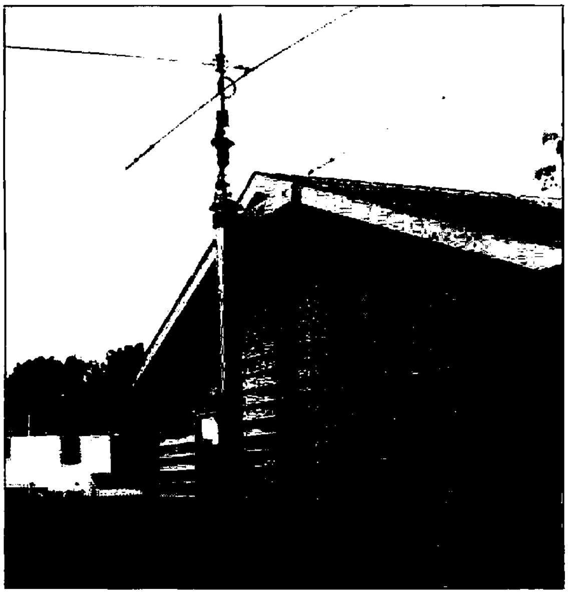
PARTS LIST

C1	0.01 µF, metal film	RS 272-1051
C2	0.001 µF, for 2,110 Hz mark tone, disc ceramic	RS 272-126
	0.001 µF plus 470 pF for 1,600-Hz mark tone	RS 272-125
C3, C4, C5	0.1 µF, metal film	RS 272-1053
D1, D2	1N914	RS 276-1122
Q1	MPS 3904	RS 276-2016
Q2	MPS 2222A	RS 276-2009
R1	10kΩ potentiometer	RS 271-218
R2	27kΩ for 2,310 Hz space tone	
	27kΩ, plus 10kΩ for 1,800-Hz space tone	
R3	50kΩ potentiometer	RS 271-219
R4	1MΩ potentiometer	RS 271-229
R5	500Ω potentiometer	RS 271-226
R6, R7	5kΩ panel potentiometer	RS 271-1740
U1	556 dual timer	RS 276-1728
U2	741 operational amplifier	RS 276-007
PC board	3⅜ x 2⅞ inch	RS 276-168
IC sockets	14- and 8-pin	RS 276-1999 and 276-1995

Fixed resistors are ¼-watt, 5% unless otherwise noted.

NEW PRODUCTS

Compiled by Linda Reneau



PRODUCT OF THE MONTH

THE WILL-BURT COMPANY/TMD SERIES 700 MASTS

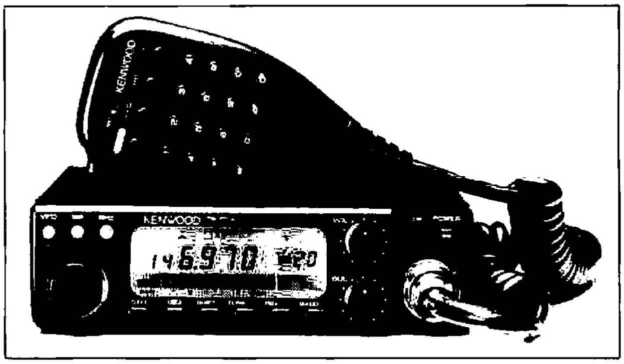
TMD, a division of the employee-owned Will-Burt Company, has a new line of pneumatic telescoping antenna masts especially designed for amateur radio. With this mast, you can quickly retract your antenna for service or esthetic concealment, support on-site emergency communications, and set up for mobile and DXpedition operation. Fast set-up and teardown, and minimum effort.

Pricing begins at $2600 for the TMD 8-30-768, nested height 7'-9", extended height 30', and weight 170 lbs. The Series 700 masts are free-standing, made of heat-treated aluminum alloy tubes (five sections) with stainless steel fasteners, with all exterior surfaces anodized and sealed. Keyed tubes maintain position, and each mast section and non-locking collar has low-friction synthetic bearings. For more specifications and model information, write or call *TMD, PO Box 900, Orrville OH 44667-0900. (216) 682-7015.* Or circle Reader Service No. 201.

CORRECTION: THE CHALLENGER DX-V

In the description of last month's Product of the Month, the Challenger DX-V from G.A.P. Antenna Products, Inc., there is an error. The Challenger, made of aluminum and stainless steel, weighs only 15 pounds—not 50 pounds. We apologize for this error and any inconvenience it may have caused you.

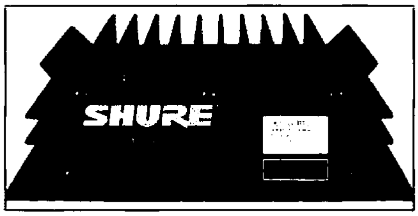
Please see the September issue for more information on this unique, elevated G.A.P. launch antenna, or contact *G.A.P. Antenna Products, Inc., 6010 Bldg. J, North Old Dixie Hwy., Vero Beach FL 32967. (407) 388-2905.* Or circle Reader Service No. 209.



KENWOOD USA CORPORATION

Kenwood's new compact FM transceivers are now available. They run 50 watts, and feature 20 memory channels, DTMF microphone with control functions, remote control head accessory, and a bright amber LCD display. You can control the radio with the 16-key TouchTone, multi-function microphone. On the TM-231A, coverage is extended 2 meter (136–174 MHz receive) for MARS and CAP, with modifiable transmit range. The TM-431A covers 450 MHz (35W) and the TM-531A covers 1200 MHz (10W).

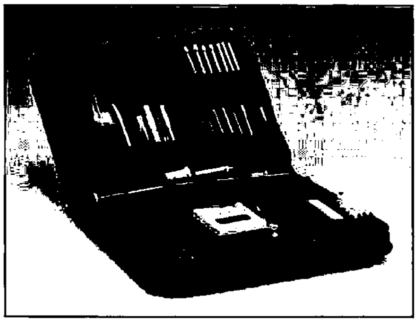
Suggested retail prices: TM-231A, $460; TM-431A, $470; TM-531A, $570. Options include the digital voice recorder and the RC-20 remote controller. *Kenwood USA Corporation, 2201 E. Dominguez Street, Long Beach CA 90810. (213) 639-4200.*



SHURE BROTHERS INCORPORATED

Shure SmartAmp™ RF amplifiers are designed to inexpensively boost transmitter output power and range of low-power, two-way radios. The mobile SmartAmp incorporates protection circuitry with LED indicators for RF overdrive, high VSWR, and thermal overload. In shutdown, the input from the transmitter bypasses the amp circuitry and goes directly to the antenna output.

Other SmartAmp features include fused supply voltage leads, a massive aluminum case, heat sink, and rugged construction. SmartAmps come in different frequency ranges and power ratings, FCC Type Accepted. Prices range from $435 to $777. *Shure Brothers Incorporated, Customer Service Department, 222 Hartrey Avenue, Evanston IL 60202-3696. (312) 866-2553.* Or circle Reader Service No. 202.



CONTACT EAST

A complete assortment of tools for servicing computer systems, personal computers, terminals, and printers is available from Contact East™. This Computer & Peripherals Service Kit contains a complete assortment of smaller nutdrivers, hexdrivers, and wrenches, RS-232 cable tools, a duplex outlet tester, a key cap puller, IC inserter/extractors, and reversible retaining ring pliers.

Over 40 tools, a small parts storage box, and optional test equipment fit into the black Cordura case. The case also features a document pocket, and two other pockets, with flaps and Velcro fasteners. Model #47-ZCD-B is $275. *Contact East, 335 Willow Street South, PO Box 786, No. Andover MA 01845. (508) 682-2000.* Or circle Reader Service No. 203.

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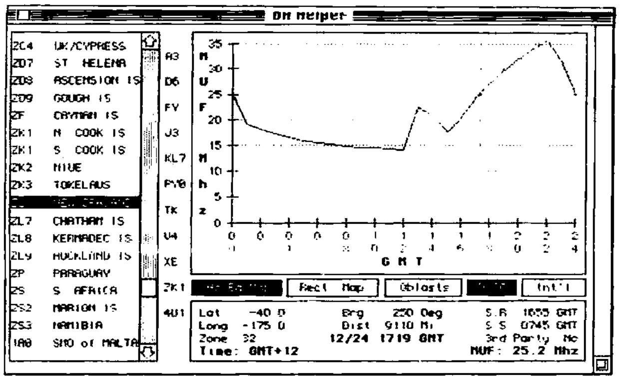


Figure 3. 24-hour propagation chart. This shows you the current time and the MUF (Frequency vs. Time) for the pointer or country location chosen on the DXCC map. From this you can determine propagation conditions for the part of the world you want to work.

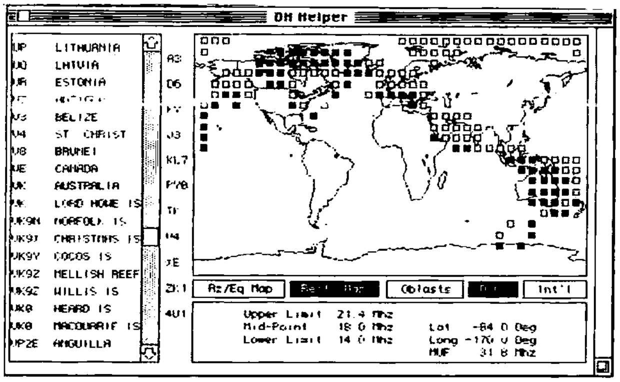


Figure 4. MUF/Area map. You enter the upper frequency limit, midpoint frequency, and lower frequency limit, in MHz. The program makes 735 calculations for locations spaced evenly over the map display, showing various MUF ranges.

several times to reach this present minimum standard.

The system clock must be set to GMT to get the proper display on the maps. Station latitude and longitude must be entered, as well as the current solar flux (available from WWV at 18 minutes after the hour). These settings are retained in a default file for the next cold startup.

What You Get

The main program is 150,067 bytes (Version 1.3) in size. Also included are four files, DXH1.LIB through DXH4.LIB. The Great Circle map creates file MAPxxxx (MAP4371 in my case). There is also a mini system folder that supplies Finder 5.3. The program is written in a compiled BASIC, which probably accounts for the large size. It also contains a lot of data. Speed, in most cases, is more than adequate for the purpose.

Good Points

The program delivers what it promises. I really like the scroll bar with the guide selections on the right. This helps preselect where to go in the list (see Figure 1). More programs should do this. This program is much handier to use than looking up the information in a magazine or a book. The price is certainly a bargain for what is delivered.

Suggestion

You can't locate a country by name to find out the callsign prefix. You have to scan the prefix list. If you point and click on the map you get the bearing, distance, etc., but not the country or prefix. (Admittedly, this is a major assignment and I do not consider it a fault!)

A Bug

All large programs have faults or, perhaps, "growing pains." I was first issued Version 1.1 to review and found a number of program bugs. I alerted Randy Stegemeyer, however, to my comments on these problems, and he quickly issued me the updated Version 1.3. I am pleased to report that all but one of the program bugs are gone in this latest edition.

The remaining problem occurs when the program first generates the Great Circle map on my QTH. The program "hangs" (stops running) when I use my QTH latitude (43.5) and longitude (71.3), yet it worked fine using any other numbers. My present solution is to use a slightly different number (change by degree) for longitude or latitude, and run again. Randy is looking for a way to correct this problem.

Drawbacks

Any use of desk accessories or playing around with the window resize will screw up the screen display. This is not a problem with the program, but rather with the way that the Mac system uses these features with a BASIC program. The main menu provides a manual RESET reset selection to restore the screen display when this happens.

I haven't been able to try Multi Finder with this program because of the limited size of my computer. Anyone with a Mac SE will be able to check this out.

None of the data is in revisable tables, so if any of it changes the program will become obsolete. This is a problem only if the DXCC country list or the Soviet Oblast' data changes.

Final Impressions

The only truly unpleasant problems I have found are the use of desk accessories with the program and the MUF/Area/GL problem. This seems to be the type of program I would like to have running in the background. However, from the bugs found, I wouldn't buy the program for that purpose until I checked it out with the author. None of the bugs are what I would call serious because no loss of user data is involved, except perhaps for the MUF/Area/GL problem.

Oblast' chasers will find the program very useful.

The code practice works well if you need practice on code groups. Its value to the program should be considered as a nice little extra touch, and not a reason for buying it.

For those of us who don't like to squint at tables in a magazine and like to have the up-to-the-minute DX forecasts using current solar data, this program rates a place in your Mac software library!

Number 37 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8½" x 11") sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Thank you for your cooperation.

Would someone please help me? I need a diagram for a Clegg Mark 3 2m transceiver and for a Regency HR-2B 2M transceiver. I will gladly pay for copying expense and postage.

Manuel Varela XE3EA
Calle 13-A #17
Prado Norte
Merida, Yuc. MEXICO

I need schematic or service information on a Regency monitor, Model TML-1, and a Tennelec Memoryscan scanner, Model MS-1. I also need programming information on the Tennelec Memoryscan. I am willing to pay for a copy or can copy and return originals. Thank you.

David Maynard WA3EZN
508 Southfield Drive
Maumee OH 43537

I need the manual and schematic for the EICO Signal Tracer Model 147. I will pay for copy and postage, or will copy and return.

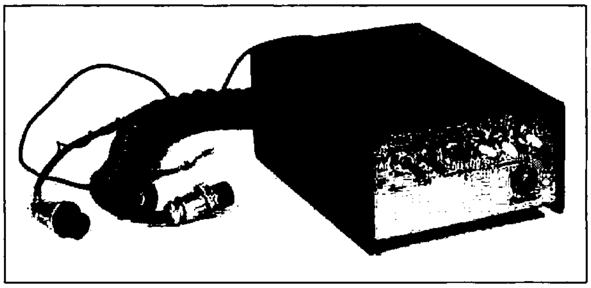
John Woehrle W6KV
151 Monroe Dr.
Palo Alto CA 94306

The Quickchanger

This makes mixed-mode/band operation a breeze.

by Howard E. Cann KA3MRX

When I was bitten by the packet bug, I bought an AEA PK-64 TNC to use with my C-64 computer. Soon I discovered that, in order to switch from HF to VHF, I had to plug and unplug radios, mikes, and wires. A real hassle!



The KA3MRX Quickchanger.

Time and Labor Saver

To solve the problem, I designed and built the Quickchanger, an inteface box that lets you switch a single mike, a TNC, a phone patch, and two speakers, all to either HF, VHF, or off. This is done with the row of six three-position DPDT toggles on its front panel.

Parts for the Box

I bought a 4" x 2" x 5" metal box to hold the Quickchanger, along with six DPDT mini-switches, various mike jacks, and RCA jacks to fit my microphones. See Figures 1 and 2 for the schematic, and the front and back panel control and connector placement. Be sure to use shielded audio cable both inside and outside the unit.

The upper position for all six switches is for VHF, the lower position for HF, and the center position is "off." To go from VHF packet to HF packet, flip the two packet switches to the lower position, then change the parameter on the TNC to HF. To go to voice, switch the two PK switches to the center ("off") position, and flip the mike switch to the either HF or VHF.

The only problem with the Quickchanger is some distortion in the audio when using the processor in the transceiver. You could easily fix this with filtering capacitors. (I didn't bother modifying mine since I don't use the processor.)

Mode Changing's a Snap!

Now, in an instant, I can switch modes and radios quickly and check for DX easily. In fact, my DX count on packet is headed toward the CC mark with the help of the Quickchanger.

You need only a mike connector to start operating the AEA PK-64, but some TNCs need accessory software, connectors, and an interface. When TNC shopping, don't be wowed by the advertising—read the small print carefully to find hidden costs for extras that are actually required items. With a happy purchase, you'll be off to a good start with the challenges and rewards of packet radio!

Parts List

1 4" x 2" x 5" metal box
6 DPDT mini-switches, center "off"
3 chassis-mount mike jacks
5 RCA chassis jacks and plugs
1 headphone jack
2 shielded mike cables
1 shielded audio cable

Howard Cann KA3MRX has been involved in radiocommunications for 30 years, but finally decided to get his ham ticket when he was a missionary in the Caribbean, because that was a more reliable link than the telephone! He currently works as a building contractor. He is also an emergency communications coordinator for Somerset County in Maryland. His other interest include boating and flying. You can write to him at Route 1, Box 146, Westover MD 21871.

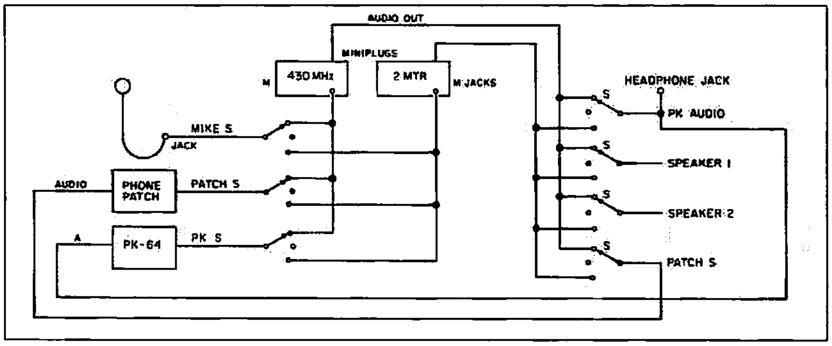


Figure 1. Wiring for the Quickchanger. It takes an hour or less to put this together!

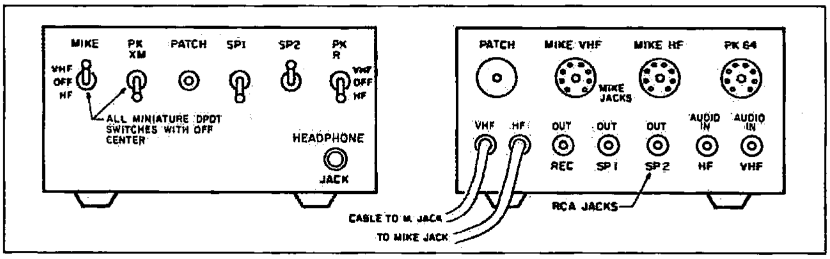


Figure 2. Front and back panel of the Quickchanger, showing port and control placement.

Number 29 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

CHICAGO IL
OCT 1

The Chicago ARC will hold its semi-annual Open House between 12 noon and 5 PM local time. Live demonstrations of equipment will be shown by experts. *Dean: (312) 869-HAMS or George, (312) 545-3622.*

ROME GA
OCT 1

The Coosa Valley ARC will sponsor its Hamfest at the Rome Civic Center. Free admission. Camper parking available, but no hookups. Tables $6, outside spaces $3. Amateur exams begin at 8 AM. Reservations requested but walk-ins accepted. *T.J. Freeman NC4G 26 Conn St., SE, Rome GA 30161, (404) 232-2830.*

HAMMOND IN
OCT 1

The Lake County ARC will sponsor its annual Hamfest at the Hammond National Guard Armory. Free parking. Limited tables $5 ea. Admission $3.50. VE testing with novices free and walk-ins welcome. Overnight accommodations close by. Talk-in on the Lake County ARC repeater at 147.00 or 146.52 Simplex. *Ken Brown WD9HYF, 918 Chippewa, Crown Point IN 46307. (219) 663-5035.*

YONKERS NY
OCT 1

Yonkers ARC is holding its Ham Fair at the Yonkers Municipal Parking Garage. Sellers: $8 per space, bring own table. No advance registration. Buyers: $4 admission, under 12 free. Talk-in on 146.865/R or 440.15/R, 146.52. *Y.A.R.C., PO Box 378, Centuck Station, Yonkers NY 10710. Or call John Costa at (914) 963-1021 or (914) 969-6548.*

ROCK HILL SC
OCT 1

The York County ARC will sponsor its Hamfest at Joslyn Park. Talk-in: 146.43/147.03. *York Co. ARS, PO Box 4141 CRS, Rock Hill SC 29731.*

SPRINGFIELD OH
OCT 1

The Independent Radio Assoc. will be holding its seventh annual Hamfest at the Clark County Fairgrounds. All vendor and swap meet activities are indoors. Admission is $3 advance, $4 at door. Under 12 free. Tables $7 advance, $8 at opening. Talk-in on 145.45/R and 224.26/R. *Independent Radio Assoc., PO Box 523, Springfield OH 45501 or call Steve Klipfel KA8QCS at (513) 882-6521.*

BILOXI MS
OCT 7-8

The annual ham/swapfest sponsored by the Mississippi Coast ARA is to be held at the Point Cadet Plaza. Free admission. Talk-in is on 146.13/73. *Edward L. Byrd KA5VFU, 18316 Landon Rd, Gulfport MS 39503. (601) 832-3249.*

WARRINGTON PA
OCT 7-8

Mt. Airy VHF ARC Pack Rats invite all amateurs and friends to the 13th Annual Mid-Atlantic VHF conference at the Warrington Motor Lodge. Also, come to the 18th Annual Hamatama, Sunday at the Bucks County Drive-In Theatre. Advance registration is $5, $6 at the door including conference. Flea market is $5 per person, $7 per carload. Selling spaces $6 each. *Pat Cawthorne WB3DNI, (215) 672-5289.*

HUNTINGTON IN
OCT 8

The Huntington County ARS is sponsoring its annual Hamfest at the PAL Club. Free parking. Handicap accessible. Admission $3.50 advance, $4 at door. 8-ft. tables $5 each. Talk-in on 146.085/.685 and 448.975/443.975. *Jim Covey KC9GX, 1752 Kocher St., Huntington IN 46750*

PORTLAND CT
OCT 10

The Middlesex ARS announces their ARRL/VE FCC license examination session the United Methodist Church. *Ed Kerns KN9Y, (203) 342-3400.*

SYRACUSE NY
OCT 14

The Radio Amateurs of Greater Syracuse will hold their 34th Hamfest at the New York State Fairgrounds. Outdoor flea-market set-up $3. Indoor flea-market set-up $7 ($6 if paid before Oct. 7th). Admission $4 before Oct. 1; $5 at the gate, age 16 and under free. Checks payable to "RAGS." Preregister for FCC exams with SASE by Oct. 7th; write *Attn: Exams, "RAGS", Box 88, Liverpool NY 13088.* For more info call *Ed Swiatlowski WA2URK, (315) 487-3417 or Viv Douglas WA2PUU, (315) 469-0590.*

WEST PALM BEACH FL
OCT 14-15

The Palm Beach County Hamfest will be sponsored by the Palm Beach Repeater Assoc. at the West Palm Beach Fairgrounds. Advance admission is $4, $5 at the door. Talk-in (input/output) 147.765/.165. Send SASE to: *From HAMFEST, P.O. Box 461, Lake Worth FL 33460.*

WAUKESHA WI
OCT 15

The Kettle Moraine RAC Inc. will hold its annual Ham/Computer/Video Fest indoors at the Waukesha County Exposition Center from 7 AM-1 PM. New, larger building. Tickets are $2 in advance and $3 at the door. Reserved tables are $3 for each 4'. Reservations accepted until Oct. 11. *KMRA Club, PO Box 411, Waukesha WI 53187.* Include SASE with order.

COLUMBIA MD
OCT 15

The Columbia ARA announces that its 13th annual CARA Ham Fest will be held at the Howard County (Maryland) Fair Grounds. Admission $4 (spouses and children free). Free parking. Indoor tables $20 each for one to four tables, $18 each for five or more. Each table includes one admission. *C.R. Whetstone WA3YOH, 211 Clarendon Ave., Baltimore MD 21208, or call (301) 486-2609.*

LIMA OH
OCT 15

The Northwest Ohio ARC will hold their annual Hamfest at the Allen County Fairgrounds. Camping (electricity $7). All night security. Free parking. Advance admission is $3.50, $4 at the door. Table reservations are $8 full, $4 half table. Send checks 2 weeks in advance. Talk-in frequencies: 146.07/67; 147.63/03; 444.925; 449.925. For table reservations contact *WD8BND, PO Box 211, Lima OH 45802. (419) 647-6513.* Handicap accessible.

QUEENS NY
OCT 14 (Rain Date OCT 22)

The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot. Buyers $3, sellers $5 per space. Talk-in 144.300 Simplex link; 223.600/R and 445.225/R. *Steve Greenbaum WB2KDG (evenings) (718) 898-5599 or Phil Kubert N2HYE (212) 777-8648.* For VEC info: *Ann Fanelli WI2G, (718) 847-0155.*

WALL TOWNSHIP NJ
OCT 15

The Shore Area Ham & Computer Fest will be held at the Allaire Expo Center (Allaire Airport), sponsored by the Garden State ARA, Jersey Shore ARS, Neptune ARC and Ocean-Monmouth ARC. Free parking. Admission: Outdoor sellers $8 per 8' wide space (first come basis). Indoors sellers $20 per table by reservation. Please make check or money order payable to *Shore Area Ham and Computer Fest, PO Box 635, Eatontown NJ 07724.* Buyers $4 advance, (tickets have two drawing stubs), $5 at the door (one stub only). Kids under age 12 and XYLs free. Talk-in: 145.110-600 KC2QI R; Simplex 146.520. Fly-in frequency: Unicom 123.0. *Al Jackson NK2O, PO Box 635, Eatontown NJ 07724. (201) 922-8121.*

SMITHFIELD NC
OCT 21

Triangle East ARA will hold its 1st Hamfest in the Smithfield Moose Lodge. Admission $4 for adults. Table and 2 chairs $6. Talk-in on 146.88. Send SASE to *Triange East ARA, PO Box 255, Smithfield NC 27577 or phone W2AC (days) at (919) 553-4309; KK4YP (nights) (919) 965-9577 5:30 PM-9:30 PM.*

GRAY TN
OCT 21

The Ninth Annual Tri-Cities Hamfest, sponsored by the Kingsport, Bristol and Johnson City Radio Clubs, will be held at the Appalachian Fair Grounds. A large drive-in indoor and outdoor flea market space is available. RV hookups. Admission $5. *P.O. Box 3682 CRS, Johnson City TN 37602*

BENSALEM PA
OCT 22

The Penn Wireless Assoc. is sponsoring Tradefest '89 at the Yezzi Field. Admission $3 each or $7 per carload. Kids 12 and under free. Spaces $5. Premium or 2x/3x wide spaces available in advance. Talk-in: 146.52/147.00+0.6. *Steve: (215) 752-1202.* For advance tickets send checks with SASE to *PWA Tradefest '89, PO Box L-734, Langhorne PA 19047.*

BROOKLYN PARK MN
OCT 28

Hamfest Minnesota & Computer Expo, sponsored by the Twin Cities FM Club, will be held at Hennepin Technical College. Expanded double-decker flea market, guest speakers, plenty of parking. Talk-in on 146.16/.76. Tickets are $4 advance, $5 at the door. Send SASE to *Hamfest Minnesota & Computer Expo, PO Box 5598, Hopkins MN 55343. (612) 474-1529.*

MARION OH
OCT 29

The Marion ARC will hold its 15th annual Heart of Ohio Hamfest at the Marion County Fairgrounds Coliseum. Large parking area. Advance tickets $3, $4 at door. Tables $6. Check-in on 146.52 Simplex or 147.90/.30 repeater. For information, tickets or tables contact *Ed Margraff KD8OC, 1989 Weiss Ave., Marion OH 43302. (614) 382-2608.*

LETTERS

Number 30 on your Feedback card

From the Hamshack

Native American Hams

Over the past couple of years I've read in *73* about your interest in ham radio activity among minorities in the US. Recently, the Little Big Horn Amateur Radio Organization, a ham group for members of the country's original "minority," Native American Indians, has formed. Membership is not limited to Native Americans; hams from other ethnic backgrounds, as well as those who have an interest in Native American culture and history, are also welcome. Currently LBH includes hams from the Cherokee, Crow, Ojibway, Oneida, Sioux, and Tlingit tribes, plus many non-Indian hams. Its goal is to build bridges of understanding and friendship between all Native Americans and other people via amateur radio.

Two code nets are conducted weekly to exchange news and interests. Both convene each Sunday. General class and above operators meet on 14.057 MHz at 2200 hours UTC. The code speed is kept to about 15 wpm. Novices and Technicians meet on 21.150 MHz at 2230 hours UTC. This net is slow code speed for easy copying. Listen for "CQ LBH" followed by a general announcement. Net control stations are WBØL in Minneapolis, MN, and WA2DAC in Peru, NY. WA2DAC is also net manager.

Visitors are welcome and encouraged to check into the nets. For more information about LBH, contact M. McDaniel W6FGE, 940 Temple St., San Diego CA 92106; (619) 222-3912.

Mick McDaniel W6FGE
San Diego CA

How Much?

In today's hi-tech world of wonders and high prices, I can see why the amateur radio ranks are dwindling. How can anyone expect that a no-code license will change the trend? It's the prices that are the problem. If *73* would offer easy-to-construct plans for CW/SSB gear for Novices, you might attract more people.

Carl Forsyth KC4IRP
Charlottesville VA

Carl, try spending more time reading the magazine. Just in '89, we ran a number of fine home-brew articles for QRP rigs (June and February), and many articles on modifying inexpensive and/or older equipment. Get in touch with us to check the article indexes for that specific home-brew project you want to build—we can likely help you!. . . de NS1B

Remember When 30 MPH was Fast?

Code is now like a fine old car. You enjoy it for its beauty, craftsmanship, and esthetic value. It also gets you from point A to point B. The bottom line, however, is that it isn't normally optimal for everyday purposes.

Barry Goldwater's statement ("Looking West," June 1989) regarding the code requirement convinced me. Not everyone needs a fine old car—or even just an older model that runs fine. I like my CW and my trusted, smooth-as-velvet, vintage Navy key, but I wouldn't expect everyone to find one and use it.

Our hobby is evolving—and so must we!

F. Paul Kosbab NF4E
Tulsa OK

Arizona Sunshine

I would like to publicly thank Senator Barry Goldwater for his help. After explaining to Senator Goldwater that the Amateur Radio Society at Arizona State University had no working equipment for 30 dedicated members, he was kind enough to donate a transceiver and receiver to the club. We would all like to express our gratitude to this fine man. Ham radio will have a rewarding future with support like we've gotten from Senator Goldwater.

Matthew Horbund KB7HYF
Tempe AZ

Pure Good Fun

I don't claim to be any better at getting kids interested in amateur radio than any other ham. I never even tried with my three boys. So, looking back, what was it that really got them interested in ham radio? It might have been the time I built them the remote control for their HO gauge trains, or it might have been when I built the transmitter for one of their model rockets, but I seriously doubt it was either. Showing each of them how to punch in WWV and other stations on my Kenwood, and operate my straight key with the sidetone oscillator, really peaked their interest as well.

But what lit up their faces the most was when I let them talk to other hams, just like ourselves, in other parts of the country. I would suggest simply letting youngsters participate, when appropriate. They learn a lot faster when they get to experience it for themselves.

Bill Gardel N3GQW
Downington PA

One of Many Modes

I view CW as just another form of communication, along with phone, packet, and ATV, and I feel it should be treated as such. If as much emphasis were placed on proper and considerate operating procedure and the omission of unnecessary power within the Novice sectors of the HF bands by individuals holding higher class licenses, I thoroughly believe that this would be a greatly improved hobby.

James T. Elliott, Sr. N3FWQ
Baltimore MD

UPDATES

Number 31 on your Feedback card

U, not I

The correct call for Dr. Edward N. Ludin of Cherry Hill NJ is K2UK. His call appeared incorrectly in "Letters" in the November 1988 issue.

C-64 and RS-232

The following corrections and clarifications are needed to the schematics in "RS-232 Port for the C-64," December 1988: the 9V AC that powers the circuit comes from pin 10, not pin 9; the PBØ pin on the edge connector is left floating; the ground on IC 1 (7660 voltage converter) is pin 3; the ground on IC 3 (the 1489) is pin 7; and, on IC 2 (the 1488), pins 4 and 5 are grounded and the output pin, no. 6, is DSR only.

PL Tone Generator

Two alterations are needed to the parts list in "CTCSS, Fast and Cheap," August 1989. Add C4 and C5 coupling capacitors at 47μF each, and change the resistance of the VR1 potentiometer to 25 kΩ.

Challenger

See the correction on last month's Product of the Month, the Challenger DX-V, in this month's New Products department. The challenger weighs 15 pounds, not fifty pounds.

Kaboom Microkeyer

Refer to the schematic in the "Kaboom Microkeyer," pages 28–29, in the September 1989 issue. Change the values of the capacitors that connect pins 3 and 4, and pins 5 and 6 of the 8044 IC, to 0.01 mF. Also, join the non-grounded lead of the 600 PIV diode to the collector leads of the two 2N2222 transistors.

Number 32 on your Feedback card

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

The torch is passed! Just as the World Olympic Games generates a friendship and bond between countries and athletes, so has the 73 International column between countries and ham radio operators. The editorial "we" are sorry to announce that our International Editor, Richard Phenix, has retired after many years at 73 Magazine. The September 1989 column was his last; 73 Magazine *and the ham community will certainly miss him. 73s to you, Richard, and may you find continued peace at your cabin at Road's End.*

This column will continue to be edited by C.C.C. until a suitable replacement can be found.

For those of you who wish to send photos for the column, we prefer color, but black and white is also acceptable. Address all correspondence for this column to 73 International, WGE Center, Forest Road, Hancock NH 03449 USA.

Roundup

Australia. The Contest Manager of the Australian Ladies' Amateur Radio Association announced the contest rules of their 1989 contest. The contest starts Saturday 11 November 1989 at 0001 UTC and ends Saturday 11 November 1989 at 2359 UTC. Further information can be received from the Contest Manager: Mrs. Marilyn Syme VK3DMS, P.O. Box 91, Irymple, 3498, Vic. Australia.

From Amateur Radio Action (ARA) via Ken Gott VK3AJU: Some different award books are available for those of you who are dyed-in-the-wool award hunters. Contact the following for further information and prices: Amateur Radio Awards (2nd Ed.), Sue Squibb G1TZU, 36 Frognal Gardens, Teynham, Sittingbourne Kent ME9 9HU UK; Amateur Radio Awards (3rd Ed.) RSGB, Lambda House Cranbourne Rd, Potters Bar Hertfordshire EN6 3JE Great Britian; International Awards Guide M.S., Lumban Gaol YB0WR J1 Garuda No. 62 Jakarta 10620 Indonesia; and the K1BV Directory of DX Awards, Ted Melinosky K1BV, 525 Foster Street, South Windsor CT 06074-2936 USA.

Calendar for October

1—National Day, China, Cyprus, Nigeria; Erntedankfest (Thanksgiving), Germany
2—Mahatma Ghandi's Birthday, India
3—National Foundation Day, South Korea
4—Independence Day, Lesotho (12th for Equatorial Guinea, 28th for Czechoslovakia)
5—Republic Day, Portugal (9th for Khmer Republic, Cambodia [Kampuchea], 29th for Turkey)
7—Foundation Day, East Germany
8—Constitution Day, USSR
9—Han-Gul Day, South Koreau; Columbus Day, USA; Thanksgiving Day, Canada
10—Health-Sports Day, Japan; Kruger Day, South Africa; National Day, Fiji
12—Columbus Day, Latin America; Dia de la Raza (National Holiday), Spain (22nd for the Vatican, 26th for Austria, 28th for Greece)
14—Young Peoples Day, Zaire
15—Evacuation Day, Tunisia
17—Mothers Day, Malawi
20—Anniversary, 1944 Revolution, Guatemala
21—Revolution Day, Somalia
22—Labor Day, New Zealand
23—Chulalongkron's Day, Thailand
24—UNITED NATIONS DAY (Dia de las Naciones Unidas) (Jour des Nations-Unies)(Tag der Vereinten Nationen)
27—3Zs Day, Zaire
30—Bank Holiday, Ireland
31—Chiang Kai-shek's Birthday, Taiwan

[*The two "Amateur Radio Awards" books are likely different.—CCC*]

Ireland. An example of ham radio generating friendship and a bond comes from the May 1989 issue of the Irish Radio Transmitters Society Newsletter. Limerick Radio Club and the South Jersey Radio Association recently announced that they have become associated as "Twin Clubs."

The "proclamation" was signed on March 1st by the South Jersey Radio Association and brought over to the Limerick Radio Club by Joe Duffin W2ORA/EI8GT, a member of both clubs.

The purposes of the twinning arrangement is to promote friendship between two Amateur Radio Clubs with a common interest, exchange valuable information regarding the Amateur Radio Service, and encourage the sharing of radio operating experiences from both sides of the Atlantic Ocean.

The arrangement was conceived by Limerick Radio Club during their 40th anniversary celebrations in 1988. The South Jersey Radio Association was pleased to be selected by the Limerick Radio Club for this honor.

While the American Club is over 73 years old, this is the first time in their long history that they have twinned with another Radio Club, and they are very proud of the arrangement. [*This is another wonderful way to develop worldwide friendships. Now is an excellent time for glasnost'. If your club has done something similar, please let us know.—CCC*]

Sweden: (Radio Sweden) GOODBYE SOS—Distress signals sent by ships in the familiar dots and dashes of Morse code are to become a thing of the past, according to the International Maritime Organization (IMO).

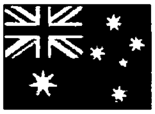
From 1993 Morse code will be replaced by the Global Maritime Distress and Safety System (GMDSS), a revolutionary high-tech system which sends a distress signal at the touch of a button.

The system, which will be compulsory in ships worldwide after 1999, has been under development since the 1970s and some of its technology is already in use on British vessels.

It works by sending a radio distress signal which bounces off a satellite to display the ship's position, name, and the time of the incident on a coastguard computer terminal. (Reuter). [*Maybe another good reason for no-code in the future?—CCC*]

U.S.A. A letter from S. Schwartz KE6XS reports that the Chaverim International Net is a group of Jewish amateurs (Jewish hams?) which meets every Sunday at 1300 UTC on 14.326 MHz. Chaverim means friends in Hebrew. The object is to promote fellowship among a worldwide group of call-ins. So far, the Chaverim Net has heard from Belize, Canada, Israel, Ecuador, Peru, and mainly the Eastern part of the USA.

Due to propagation, the So. California section is asking all interested Jewish amateurs west of the Rockies to join another Chaverim net at 1600 UTC on 14.326. Hopefully this will also include calls from many other areas.



AUSTRALIA

Ken Gott VK3AJU
38A Lansdowne Road St. Kilda
Victoria 3183, Australia

What's new (or news) in VK-land? On the awards front, we have a Worked All VK Call Areas award which is far and away the most popular WIA Award. I recently had a batch of 29 applications in one envelope (naturally, a big one) from the USSR, about half from hams and the rest from SWLs, since the award also exists in an SWL form. There is also a VHF version of it. Recently the first VHF WAVKCA award went to Yoshiteru Mori JA2BZY.

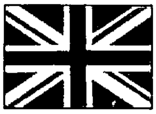
Apparently there are lots of J hams, including Yoshiteru, who only needed the VK0. Suddenly the break came—in the form of VK9YQS/VK0 on Macquarie Is., on 6m.

Prior to this, I had a phone call from a 6m specialist alerting me that about 50 J stations would be applying for the VHF WAVKCA. So far, no great rush—only about six applications. But even six is a landmark for this particular award. Maybe the dozens of Japanese stations that made it to VK0 on 6m still need some other call areas—hard ones like VK9. We will see.

On a more personal level, I'm moving the shack. We have a large, solid brick structure designed as a garage, but never

used as such. I've had power laid on to it and pretty soon will paint the inside, install a ceiling, and generally fix the place up. The biggest job will be getting rid of the old furniture in it.

Then will come a tower. To date I've only had a G5RV. I've confirmed about 160 countries with it, but the time has come to move to a beam. I consider myself semi-retired. As an economic-cum-whatever consultant, I tend to gear my income efforts to my needs. The needs are now acute, in view of the need of a tower, etc. [*Ken is presently attempting to ascertain the life (dead or alive) of over 70 awards "offered" in VK. Quite an undertaking.—CCC*]



HONG KONG

Philip J. Weaver VS6CT
G.P.O. Box 12727
Hong Kong

Phil writes that he contacted the Post Office that administers the licensing in Hong Kong and asked them to approve "The 73 International Universal Permit Application." He sent us a copy of their reply.

They have no objection to visiting radio amateurs using the international application for a visitor's amateur station licence or licence under reciprocal agreement in Hong Kong. However, the applicant should submit his application in accordance with certain notes on their standard application form, i.e.:

(a) The applicant should submit the application in person, bringing the original copies of the required documents for verification (the originals of the Radio Amateurs' Examination Certificate or pass slip, Passport, Hong Kong ID Card, current amateur licence issued by other administration, etc., should be produced for verification in person to: The Maritime Services Section, Telecommunications Branch, 5th Floor, Sincere Building, 173, Des Voeux Road Central, Hong Kong).

(b) If the applicant is under 21 years of age, the licence will be issued in the name of the parent or guardian, and parent or guardian information will be required. The parent or guardian will be responsible for the observation of the licence terms.

(c) The applicant should sign the declaration provided in para. 6 of the Hong Kong application form. [*The Annual Licence Fee is HK$150. . . CCC*]

Photo A. JS, VU2JX, making one of the many contacts from VU7JX.

INDIA

J. Srinivasan VU2JX
340 5th Main Koramangala
Bangalore, 560 034 India

73 International is pleased to announce that J. Srinivasan (JS) is our new Hambassador in India. JS enclosed an article written on the team that went to the Laccadives in March 1989 (VU7JX) and emphasised RTTY through the BARTG Contest.

DX-PEDITION TO THE LACCADIVES: VU7JX

"HOW ABOUT PUTTING LACCADIVES—VU7—ON THE RTTY MAP FOR THE BARTG CONTEST?" This early morning call from J.S. (VU2JX) to me did unleash a whole chain of the most unexpected events. It was 4 March 1989.

Within the hour, a member of a DXpedition already in the Laccadives was contacted on 40m to check if they would let us operate RTTY for the BARTG contest. . . but no enthusiasm showed up. Before the night was out, Nat (VU2NTA) and Vidi (VU2DVP) swelled the size of the team to a forceful four.

John Troost (TG9VT), the catalyst of this idea, was informed promptly and the whole RTTY clan got to know: the first ever VU7 on digital mode! Special permits to the islands were applied for.

Passage from Bangalore to Cochin, Cochin to Agathi and then to Bangaram and back was booked. It had to be postponed, cancelled and rescheduled several times before our arrival, *en fin*, at Conchin ultimately on the 15 March, with bags and baggages of rigs, antennae, masts, et al.

All domestic and business affairs were rearranged. There was nothing in our collective consciousness except getting to the Islands and getting on the air. Were we surprised to know that no ship was to leave for the Islands before 18 March, the date of commencement of the contest! The twice weekly turbo-prop flights had been cancelled. The heroic aircraft needed maintenance and recertification, having reached the end of its certified life! The availability of a helicopter was annoyingly uncertain, and its capacity to carry the beam, mast and other equipment in doubt!

The formidable Bernie (SWL Bernard Abroa) and vigorous Vidi brought in the whole bunch of aviators to our chambers and saw to it that we got into Agathi not too far behind our antennae.

The multi-hued sunset and the much wearied team landed together on the paradise on earth—the Bangaram Island, in Lakshadweep as the Laccadives is known in India.

Can we ever thank enough the sporty tourists—foreign and Indian—who carried the antennae and mast literally on their willing shoulders throughout their cramped flight? Can we ever forget Capt. Krishnan, our pilot, who strayed into our shack and stayed up well into early morning and lent

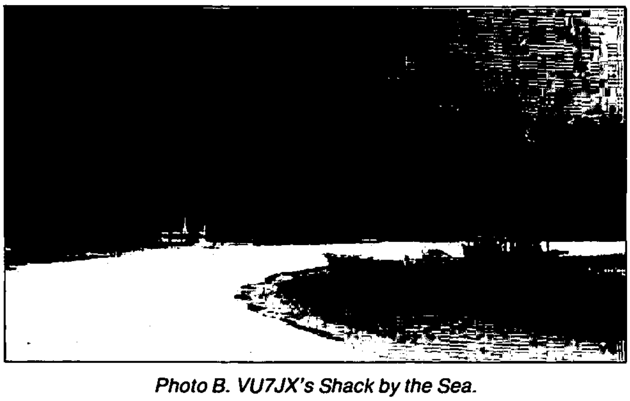


Photo B. VU7JX's Shack by the Sea.

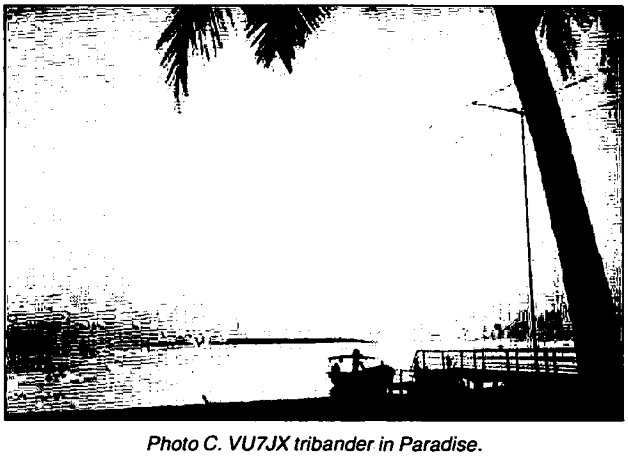


Photo C. VU7JX tribander in Paradise.

his strength—physical and moral—as we put the antennae up and set out the rigs?

Utterly unmindful of the strong superstition of the Islands of not climbing trees after dusk, an admirably agile angel went up and down the sky-reaching coconut-trees and strung up our dipoles for 40 and 80 metres. In the cool breeze of the early morn—at 2130 hrs UTC (it was 3 AM local time on 17 March)—VU7JX's first call emanated from the palm-thatched, airy cottage, set right on the very lap of the loveliest lagoon. **What a take-off point! What a view!! Window to the world indeed!!!**

Thanks, Arasu. You and your adorable XYL made us feel absolutely at home right away. Unceasing (diesel) power and unlimited hospitality! You and your boys are not employees of the resort, not stay longer and work all of you, out there, beaming towards Bangaram. One h(sw)ell of a pile-up!!!

The unpolluted air was a magic healer; the balmy weather, a tonic. Every meal a veritable repast: succulent tuna, tasty lagoon-fish, tender chicken and juicy beef, every morsel delicately grilled and caringly offered. The heady palm-juice or the chilled beer. . . sheer ambrosia!

The coral Laccadives (meaning a lakh of islands), populated by graceful people and generous coconut palms, surely wear Bangaram (the golden one) as the crown. In shape a doughnut, adorned by lush green and cerulean blue waters, miles to wade in, swim, snorkel, paddle or wind-surf.

Thank you, micromaniacs, who write soft-wares on propagation.

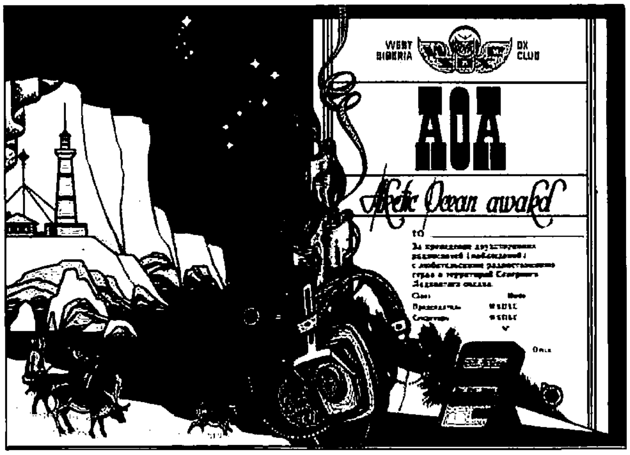


Photo D. AOA Arctic Ocean Award from the West Siberia DX Club, sent by UA9MA. Loosely translated by Bryan NS1B: "For two-way communications (observed) with amateur radio stations of the countries and territories of the Arctic Ocean."

but our expansive hosts.

The lights that were switched on in the shack in the evening on 16 March were put out only after the antennae were brought down and everything packed in the wee hours of 24 March.

What a ready and resounding response we found from fellow-hams throughout the dxpedition! Memorable! A deeply satisfying contest of six hundred plus RTTY points and around five thousand CW and Phone QSOs indeed moved us towards forgetting and nobly forgiving the intentional QRM; but can we ever forget those guardian angels ever present with us on every band and politely policing it?

Since our QSLs are already arriving at their various destinations, our only regret is that we did Based on your predictions we got onto the contest several hours after the start of the contest; and it did pay rich dividends!

Special thanks to you, John (TG9VT); but for your not so gentle-goading, we would have regrettably let this possible DXpedition pass us by. A51 can not be far for us if you are by our side!

Reels of strong wire-rope, the sturdy antenna-mast and our hearty greetings are left behind with Arasu, the Manager of the Island Resort for you hams, arriving there in the not so distant future.

Must all good things ever come to an end? .... Until then, 73s, Rom VU2RUM Box 4250, Bangalore, India.

*[**When do we leave, Wayne??** —**CCC**]*

Number 38 on your Feedback card

TECH TIPS

Pearls of Tech Wisdom

Secret Bandwidth

As the product literature indicates, when the ICOM IC-761 is in SSB mode, its bandwidths are 2.4 kHz and 2.6 kHz with the filter switch in the "in" and "out" positions, respectively. However, there is a third bandwidth for receiving on this radio. Leave the filter switch in the "out" position and place the IF shift button in the "in" position for IF shift, and the bandwidth becomes 3 to 3.2 kHz wide.

When using just the filter switch to select the advertised wide and narrow positions, you receive and transmit using both the 9 MHz and 455 kHz filter; when using the above method for wider selectivity, you're apparently receiving through the wide ceramic 455 kHz filter only, bypassing the 9 MHz filter. Here's the pertinent data:

9 MHz	455 kHz	Bandwidth
FL-80	CFJ-455K5	2.6 kHz
FL-80	FL-44A	2.4 kHz
By-passed	CFJ-455K5	≈3.0 kHz

Jim Nance KE4WY
Douglasville GA

A Real Turn-On

If your ICOM with an internally switched power supply turns off when you don't want it to, leave it turned off and unplug it for about a minute. Then plug it in and turn it on. Assuming everything else is okay with the rig, the radio should come back on and put you where you left off, because, while the power supply has no fuse, it does have an auto-protection circuit.

Bill Hickox KB5DZ
Houston TX

Super Simple Solution

If you use an IC test clip for troubleshooting, you've probably discovered that the test contacts are so close together it's difficult to attach a probe without touching adjacent contacts, and touching the wrong contact can cause damage in some situations.

If the contacts are long enough, this fault can be corrected by bending some of them. On one side, bend every other contact outward about 45 degrees and bend the remaining contacts inward. On the other side, the contacts opposite those that were bent inward should be bent outward, and those opposite the ones bent outward should be left alone. This also makes it easier to count to find a particular pin. The photo shows how easy it is to attach a probe with the wide spacing that results.

Charles E. Cohn KK4CS
Austell GA

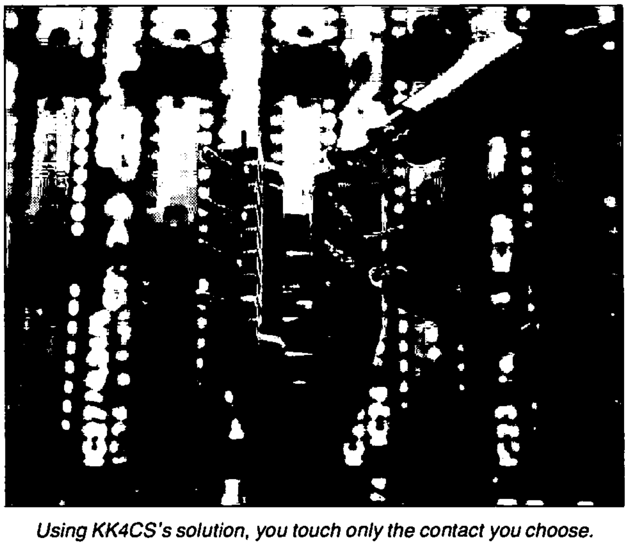
QSK at 30 WPM

High-speed keying is great, but it can create problems. When pounding code into the Kenwood TS-440S at about 30 wpm, the QSK starts to shorten transmitted RF signals and you may get bad tone reports. To correct the situation, Kenwood suggests altering the delay and rise times by changing components in the IF unit (X60-1300-00) as follows:

Make the value of resistor R151 47kΩ, instead of 10kΩ; make the value of resistor R200 100kΩ, instead of 82 kΩ; and make the value of capacitor C166 1 μF, instead of 3.3 μF. These components are located in the IF unit between the optional SSB filter and the front edge of the PCB.

Jussi Torhonen
OH7DC/OH3NWP
Riihimaki Finland

The above items, except "Super Simple Solution" are adapted from International Radio Inc..



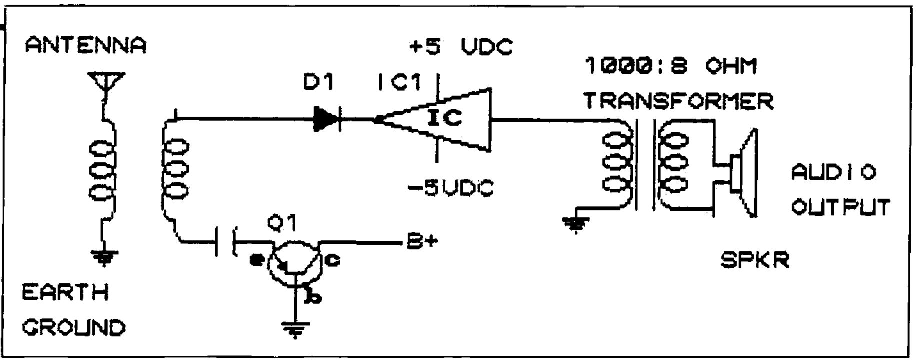
Using KK4CS's solution, you touch only the contact you choose.

73 Review *by Michael Simmons WB9CWE*

Flodraw

Drawing schematics on your PC.

Public Brand Software
PO Box 51315
Indianapolis IN 46251
Price Class: $5



A simple schematic drawn using Flodraw.

Have you ever wanted to use your PC and dot-matrix printer to quickly produce schematic diagrams, but you didn't have the software for it?

For just a few dollars, you can own Flodraw, a graphics editor program with ready-made electronic symbols, and drawing and editing functions.

The Price is Right

Flodraw is shareware, which means you can legally copy it from different sources for free, or for a nominal fee, and evaluate it for your needs. If you don't like it, you can discard it with little or no loss. If you do like it, you can register with the author for $25, or $35 if you want updates and assistance.

Flodraw comes on two disks, and works with most PC compatibles and printers. You don't need a mouse or joystick. Although it's mainly for drawing computer flowcharts, it has libraries for electronic, organization, and other symbols. Just select what you want from the menu.

The library has 22 symbols for drawing schematics. You can modify these and save your modifications and schematic drawings. The beauty of Flodraw is that you can place, move, or edit a symbol, connecting line, or group of components very rapidly and accurately. If you get stuck, you can display the help screen by pressing ALT-H.

Creating and Editing Your File

When you begin, Flodraw will prompt you for the name of your file, type of library, and printing format. Type the name of your file, whether new or previously saved, and select the "Electric" library.

In the editing mode, Flodraw uses a window, which means you only see a part of the total picture. As you bring the cursor across the screen, the window will move across the work area. For rapid movement, you can use the PG UP and PG DN keys. ALT-R and ALT-L move the window right and left.

If you get lost, you can press F2, the View function, for an overview of your whole work area with reduced resolution. An on-screen ruler helps you pinpoint your location.

Pressing the F1 key alternates between the two editing modes: text mode and drawing mode. In text mode, you can type, move blocks of drawing, and call up symbols. In drawing mode, you can refine your drawings and produce connecting lines between components.

For example, let's say you want an antenna symbol. Place the cursor where you want the antenna symbol, press F10 to bring up the symbols, then press the function key which corresponds to the antenna symbol. The symbol will pop onto the screen. Made a mistake? Press F9 and the symbol vanishes.

When you're drawing lines between components, the menu will prompt you on positioning the cursor and let you know when to press F4 to indicate the line's beginning and end.

Using the block functions, you can rotate, delete, copy, or move symbols or groups of symbols anywhere in the diagram you wish.

Producing New Images

You can type text anywhere in the schematic with a number of font sizes. Some symbols, such as the one for IC, are already labeled. You can modify them as you wish. Let's say you need the symbol for an iron core choke. First, call up the transformer symbol. Position the cursor to the left of the unwanted windings, and press the spacebar to erase them. You now have your choke symbol, which may be stored in the library for future use.

Drawing a nonlibrary item, such as a tube or MOSFET symbol, is trickier. You have to call up a circle from the menu, then draw in the lines with the arrow keys. This is a little time-consuming, but not impossible, and once drawn and saved, you'll have it instantly available in the future.

If you've saved a circuit on disk that would be useful in your present diagram, you can use the Merge function to bring it up and place it exactly where you need it.

Printing Your Drawing

Flodraw offers three printing formats: the portrait, 8.5" x 11"; the landscape, 11" x 8.5"; and the large landscape, 16" x 11", or two-page format.

As for hardware, printers which support Flodraw are the Epson, IBM, Toshiba, and any printer which emulates the graphics modes of these printers. My Star NP-10 works well in IBM mode. Print times vary from three to nine minutes, depending on the type of printer, and whether you select single-strike or double-strike printing. The print quality is quite good.

Several Drawbacks

The F9 (Undo) function only works on an immediately preceding operation. if you decide that earlier work needs to be eliminated, you have to use the text cursor and spacebar or the Block-delete function. These are a little cumbersome, and they don't always permit complete erasure of a line or symbol.

Also, when you initially place a symbol on the screen, it will be perfectly placed for clean, easy line connections to other symbols. But if you rotate it, its center will shift, and drawing a straight line to it from another component will be almost impossible. You can get close to connecting a line to one of its ends, but you may have to draw a diagonal line to fully connect. This isn't a major problem; it's just that the connections do not look perfect.

Conclusion

I found Flodraw well worth looking into. A 54-page, well-written instruction booklet and a 15-minute tutorial are included on the disks. They provide excellent help while learning the software.

You can download copies of Flodraw from some computer bulletin boards, or buy a copy for a few dollars from mailorder shareware distributors, such as the one listed at the top of this review.

Michael Simmons WB9CWE has been in amateur radio since 1970, and especially enjoys 20m RTTY. He currently owns and runs a small publishing company. Michael can be reached at 101 Harrison Ave., Charlestown IL 61920.

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PROPAGATION

Jim Gray W1XU

by Jim Gray W1XU
PO Box 1079
Payson AZ 85541

October Activity

This month will find excellent HF propagation on all of the HF bands between 40 and 10 meters, and even 80 meters will begin to look a bit lively. The first week of the month will exhibit variable conditions ranging from good to poor, while the second week of the month is likely to be the worst.

Both electromagnetic and geologic conditions will bring surprises—most of them *unwanted*. The third and fourth weeks of the month will present a vast improvement, down to and including the last days of the month, but due to days of excessive ionization, high absorption can still occur and deep fading may prevail on the DX bands. Six meters will be active, as will 10 on up, as Old Sol races to an early peak of Cycle 22, possibly in mid to late 1990. Make the most of your DX opportunities this month, as many will exist. Keep an eye on developments via WWV at 18 minutes past each hour, and of course, through the charts provided in *73*.

Get Ready for DXing

Use the MUF chart for bands and countries, but use the calendar for daily summaries of conditions. Bear in mind that specific onsets of poor or good conditions may vary by as much as a day or two, due primarily to the increasingly unpredictable nature of the sun at times of high solar activity. Strong sunspot groups can produce flares and sudden ionospheric disturbances that may even create HF communications "blackouts" for several hours at a time on the days marked "P." ■

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15*	20	20	20	—	—	—	—	—	—	—	15*
ARGENTINA	15	15	20	20	40	—	—	10	—	—	10	10
AUSTRALIA	10	15	20	20	—	40	20	20	—	—	—	10
CANAL ZONE	15	40*	40*	40*	40*	—	20	10	10	10	10	10
ENGLAND	20	40	40	40	—	—	20	10	10	10	15	20
HAWAII	10	15	20	20	40*	40	20	20	—	—	—	10
INDIA	20	20	—	—	—	—	—	15	—	—	—	—
JAPAN	15*	20	20	20	—	—	—	—	—	—	—	15*
MEXICO	15	40*	40*	40*	40*	—	20	10	10	10	10	10
PHILIPPINES	—	—	20	20	—	—	20	15*	15*	—	—	—
PUERTO RICO	15	40*	40*	40*	40*	—	20	10	10	10	10	10
SOUTH AFRICA	40*	20	20	20	—	—	—	—	10	10	10	15
U.S.S.R.	—	40	20	20	20	—	—	10	10	15	20	20
WEST COAST	10	15	20	20	80/40	80/40	—	—	—	10	10	10

CENTRAL UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15	20	20	20	—	—	—	—	—	—	—
ARGENTINA	15	15	20	20	20	—	—	10	—	—	10	10
AUSTRALIA	10	15	15	20	20	40*	40	20	—	—	15	10
CANAL ZONE	15	15	20	20	—	40	40	10	10	10	10	10
ENGLAND	—	—	—	—	—	—	10	10	15	15	20	20
HAWAII	15	15	20	20	40*	40*	40	20	—	—	10	10
INDIA	—	20	—	—	—	—	—	20*	15	—	—	—
JAPAN	10	15	20	20	20	—	—	—	—	—	—	—
MEXICO	15	15	20	20	—	40	40	10	10	10	10	10
PHILIPPINES	15	—	—	—	—	—	—	20	10	10	—	—
PUERTO RICO	15	15	20	20	—	40	40	10	10	10	10	10
SOUTH AFRICA	20	20	20	—	—	—	—	—	10	10	15*	15
U.S.S.R.	—	—	20	—	—	—	20	15	15	15	20	20

WESTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15*	—	20	20	20	20	20	20	20	—	15
ARGENTINA	10	15	15	20	20	20	—	—	10	—	10	10
AUSTRALIA	10	15*	15*	20*	20	20	40	—	—	—	—	10
CANAL ZONE	10	15	15	40/15	40/15	—	—	—	15*	10	10	10
ENGLAND	—	—	—	—	—	—	—	—	15	20	15	—
HAWAII	10	10	15	20	40*	40*	40	40	15	15	—	15
INDIA	—	[illegible]	—	—	—	—	—	—	[illegible]	15	—	—
JAPAN	10	15*	—	20	20	20	20	20	20	20	—	15
MEXICO	10	15	15	40/15	40/15	—	—	—	15*	10	10	10
PHILIPPINES	10	10	—	—	—	—	—	—	20*	15	15	—
PUERTO RICO	10	15	15	40/15	40/15	—	—	—	15*	10	10	10
SOUTH AFRICA	20	20	—	20	—	—	—	—	—	10	15	15
U.S.S.R.	—	—	—	20	20	—	—	—	15	15	20	20
EAST COAST	10	15	20	20	80/40	80/40	—	—	—	10	10	10

* Try next higher band (1) Difficult path

OCTOBER 1989

SUN	MON	TUE	WED	THU	FRI	SAT
1 P-F	2 F-G	3 G	4 G-F	5 F	6 F-P	7 P
8 P	9 P	10 P	11 P	12 P	13 P	14 P
15 P	16 F	17 P-F	18 F	19 F-G	20 G	21 G
22 G	23 G-F	24 F	25 F-G	26 F	27 F	28 F
29 F-G	30 G	31 G-F				

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73 AMATEUR RADIO

NOVEMBER 1989 Issue # 350

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FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

Cover by Alice Scofield
Cover Photo: Flavorig! (see page 12)

See page 17 for more on Nickol KB2GGW.

WELCOME NEWCOMERS

Books for Newcomers

Uncle Wayne's Bookshelf offers some great books for beginners, and I want to share my favorites with you. From time to time, we receive letters from readers complaining that we have little to offer newcomers, or that they don't know where to begin to learn about amateur radio. Usually I copy the *Bookshelf* from the most recent issue of *73*, circle my favorites, and send it to the inquirer. In this *Welcome Newcomers*, I thought I'd go a step further and let you know *why* they're my favorites.

Can It Really Be That Cosmic?

Tune in the World with Ham Radio, an **ARRL** publication, is a good place to start. It's easy to read, well-organized, and visually stimulating—especially the cover of the 7th edition. A translucent road unravels through the galaxy, disappearing into what looks like the Crab Nebula. A couple of novae peer out at you from the depths of space, while a shiny, flying transceiver swoops through a rift in spacetime, darting off at an angle, its top glinting with stardust. A glowing earth nestles inside the chassis, behind the dials.

This 222-page, 8½"x11" book contains everything you need to know to pass your **Novice Class** written exam, and more. But not too much more, just enough to give you some background. It opens with a chapter on ham activities, **OSCAR** history, and the diversity of the ham community. The next chapter outlines basic operating procedures, the kinds of licenses and their privileges, the ethics of the Amateur Radio Service, and **FCC** rules.

Three chapters totalling 26 pages introduce you to electrical theory, electronics, parts, and circuits. This includes photos, sidebars highlighted in blue, and diagrams. The few important equations you need to know are easy to spot.

The next three chapters cover hardware. What do you look for in equipment? What do all the knobs, dials, and switches do? What kind of antenna do you need, and should you make your own?

One chapter is devoted to getting on the air. It has tables of **Q-signals**, correct **CW** procedures, widely used CW abbreviations, the **RST** system, and much more in just twenty pages. The last couple of chapters deal with **packet**, Novice privileges, modes of communication, and troubleshooting common problems. The complete question pool for the Novice license exam, Element 2, is in the back of the book, along with the answers.

I like this book because the writing style is simple and direct, the layout emphasizes the essential, a handy key word glossary is at the beginning of each chapter, and helpful tables and diagrams are at the back of the book. Price, $12; with code practice tapes, $15.

More General Coverage

The Beginner's Handbook of Amateur Radio, by Clay Laster W5ZPV, is another winner. My hands get warm just holding this inch-thick, 8¼"x5", 418-page volume. Although it's easy for the beginner to read, it's meaty and nourishing.

It contains basically the same information as *Tune In*, but it's organized differently. Technically, it's slightly more detailed, and sample test questions are scattered throughout the book. The style is clear and direct, but not dry. Price, $16.95.

For a dollar, you can get a little ARRL booklet titled *Operating an Amateur Radio Station*. It packs a lot in 42 pages.

Reaching for the Sky

Should you buy or make your first antenna? What kind of antenna should you use, vertical or dipole? Can you convert Uncle Charlie's old 27 MHz CB antenna to 10 meters?

Easy-Up Antennas for Radio Listeners and Hams, by Edward M. Noll (8½"x11", 158 pages), can give you a lot of ideas. It offers precise dimensions, neat diagrams, and just the right dose of theory.

For the Novice, it explains how to make a vertical for 15 meter **DXing**, a 40m sloper, a 2-element 15m inverted-V beam, a 10m elevated vertical, a 2-band inverted dipole, a tuner and 15/40m dipole, a random-wire with tuner, and 1¼m VHF antennas.

Several chapters apply to all types of antennas, and the author instructs you to read these before you begin construction. There is a special chapter for Technician and VHF/UHF antennas, and another for General and Advanced Class operation. The Appendix lists manufacturers and sources of information.

The beauty of this book is that while it's easy for beginners to understand and use, it's also a practical resource for experienced hams. Price, $16.95.

Doug DeMaw W1FB's **Novice Antenna Notebook** is full of ideas, tips, and knowledge gained from years of experience. I would recommend both of these books for the beginner, and I can't really say which one you should buy first. 8½"x11", 124 pages. Price, $8.

What's All the Packet Racket About?

You've probably heard that **packet**, a system of **digital communications**, is the new frontier of amateur radio. To find out what it's all about, I recommend **Your Gateway to Packet Radio,** by Stan Horzepa WA1LOU. It's 8½"x5, 207 pages. Price, $10.

Or you may prefer *The Packet Radio Handbook*, by Jonathan L. Mayo KR3T, or *Mastering Packet Radio*, by Dave Ingram K4TWJ. As to content, both of these books look just as good as *Gateway*, but I prefer the latter because of the inclusion of tables and other references at the end of the book as appendixes.

For an overview of digital communications modes, try **The Digital Novice,** by Jim Grubbs K9EI. Size, 8¼"x5", 128 pages. Price, $8.95.

Beginning Construction

One Evening Electronics Projects, by Calvin R. Graf and Richard S. Goss, is excellent. After describing each of the 16 projects, the authors provide construction tips. Each project merits a full chapter. 7¼"x9½", 174 pages. Price, $8.95.

Hints & Kinks for the Radio Amateur, 8½x11", 130 pages, is full of "practical ideas from the pages of *QST*," as the publisher claims. Modifications, tips, information on the quirks of specific equipment, updates, and improvements make this book not only useful, but enjoyable for browsing. Price, $5.

CW—Do It Just for Fun

The third chapter of *Tune In* gives some good advice on learning code, and directions for building a code-practice oscillator. ARRL code tapes come with this book as a kit. Check Uncle Wayne's Bookshelf for postal rates and more information. W5ZPV, in *The Handbook*, also devotes a few pages to learning and practicing code. GGTE's Morse Tutor ($19.95), and our 5 and 6+ wpm code tapes, "Genesis" and "The Stickler," are excellent ($5.95 each).

Everyone has advice about learning code. Mine is this: Just play with it, for fun, as you would a video game. Second, don't worry about how long it takes. Just do it every day for about twenty minutes. Third, if possible, don't take the test until you're really comfortable copying at about 7 wpm. Then, on test day, you probably won't have to worry about whether you'll pass or not; you can be pretty sure you will. . . de Linda KA1UKM

GLOSSARY

ARRL American Radio Relay League.

CW Morse code. Code is produced by interrupting a *continuous wave* signal with "dits" and "dahs."

Digital Communications Information designed to be received and printed automatically; transmissions used for the direct transfer of information from one computer to another; data in binary code (on/off, "1", "0").

DXing Long distance hamming, especially contacting foreign countries.

FCC Federal Communications Commission.

Novice Class license The most basic amateur radio operator's license class. You can upgrade from Novice to Technician, General, Advanced, and, finally, to Extra.

OSCAR Orbiting Satellite Carrying Amateur Radio.

Packet A system of digital communication where information is broken into short bursts containing addressing and error-detection information.

Q-signals Three-letter groups which facilitate CW communication, such as "QTH" for "location."

RST A standard system of reporting *readibility, strength, and tone* of a contact.

Number 2 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

How To Attract Youngsters

A letter from a reader described the ham radio display at the recent Canadian National Exhibition. Alas, apparently those in charge hadn't read my editorials. The display was almost entirely involved with how difficult it is to get a ham license, with not a hint to the visitors of how much fun they might have if they joined us.

There was a big sign listing what subjects are on the license test, a sample study guide, details on rules and regulations, a Morse Code key, a sample license, info about signing up for classes . . . and, wow, a world globe. Was there even a hint to explain why anyone should bother to go to all this trouble? Nope.

I'm sure the Canadians involved will opt to shoot the messenger and get mad at me for saying anything, instead of making sure that any future efforts to interest youngsters in amateur radio are better conceived.

I just wonder if you might not do exactly the same thing, were you in their shoes. I've never seen a good ham radio display aimed at the general public. Most of 'em are like the ARRL Ham's Wide World videos—largely self-congratulatory, with almost zero sales effort.

Give it a try. Can you come up with anything you might tell youngsters to try and get them interested in hamming? Would you start right in explaining the details of how to get a license or would you do a little selling of the sizzle first? If so, what would you say?

The above gave me a great idea on a new way to sell amateur radio to newcomers. Presuming that sometime in your ham career you've had some fun, the first step is for you to see if you can remember what you did that was fun. Any luck with that?

Now, amateur radio, being largely an audio hobby—except perhaps for home construction, slow scan and certificate hunting—how about our putting together an audio cassette with an illustrated sales message about amateur radio? Do you think, if we all work together on this, that we can come up with an hour tape which will demonstrate how much fun we're having with amateur radio?

If you'll record the needed sound bites, I'll add an enthusiastic sales pitch on our hobby and make the cassette available for sale at future ham displays, expos, malls and so on. It'll be something both to help sell amateur radio and to get the kids to come to classes, as well as a way to offset some of the expense of exhibits.

Can you come up with 30-second to three-minute sound bites which illustrate how much fun you're having with amateur radio? Put some new batteries in your cassette recorder and let's see what you can do. Yes, of course I'll give credit for the individuals or clubs that come up with usable sound bites.

Can you break the ice and get a rare DX operator to tell you something interesting about his country, while talking so an untrained listener can understand what's being said?

I'll see if I can get King Hussein to say a few words about how much amateur radio has meant to him—and to Jordan. And I'll bet we can get Barry Goldwater to tell an interesting story about a ham contact.

We should have a lot of aurora this winter, so be sure to send me some 2m aurora CW contacts. What can you do for me in an unusual repeater contact? Anything like the one I had almost twenty years ago from my HT on a street corner in Las Vegas in a round table with Phoenix, San Diego and San Francisco? I expect not . . . surprise me.

No, I don't think I need any tapes of Los Angeles repeaters. Thanks, anyway.

I wonder if I can find my old tape of G2PU calling CQ on 75m one afternoon, boiling through on the East Coast? Well, that was exciting for me, but I doubt a youngster would appreciate it. Never mind.

Yes, I'll have a booklet with the tape so we can show slow scan pictures, an inexpensive modern computerized Morse/RTTY/packet station, some simple antennas, a flea market, a typical low cost ham station, an HT, a drawing of how a repeater system works, a tiny homemade QRP rig, a direction finding antenna . . . things like that. But the key to the whole works will be the tape—and you've got to do the leg work for that. You give me the material to work with and I'll give you a great sales tape.

I'm going to be watching club newsletters, looking for mention of this project, inciting the members to get busy taping. If all I see is business as usual, is there any reason I shouldn't believe your club could care less about what happens to our hobby?

Once you send your cassettes to *73 Magazine*, Forest Road, Hancock NH 03449, my goal will be to provide a cassette and booklet sales package

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock, NH 03449, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

which will bring us a flood of new hams and also make a profit for clubs. Please get your tapes in by January 30th at the latest.

Isn't That Odd?

The repeat PBS broadcast of the Nova program on Richard Feynman, the Nobel physicist who died last year of stomach cancer, got me to thinking. Dick's the chap who upset the Morse Commission Challenger disaster investigation by pointing out what happened to the O-rings when they were chilled, a fact the other team members missed. Dick went through life noticing things which didn't quite fit into accepted dogma. Please look for his paperback book, *"Surely You're Joking, Mr. Feynman!"* You won't find a more enjoyable use for $8.95.

For instance, isn't it odd that there are a few people who can do incredible math problems in their heads? Isn't it odd that some people can read printed type in total darkness with their fingers? Isn't it odd that many people are able to sense colors by feel in total darkness? Isn't it odd that almost everyone, no matter their religion, who has a near-death experience, reports essentially the same events? Isn't it odd that some people can communicate mentally, consistently sending long messages with zero errors? Isn't it odd that a few people have been surprisingly successful in seeing future events? Isn't it odd how alike twins can be, even when separated at birth? Isn't it odd that almost everyone, when regressed under hypnosis, can contact past lives?

It's not difficult to find thousands of such anomalies. The easy response is to reject them. Somebody exaggerated or lied, right? Let's throw out tens of thousands of UFO reports too, OK? Throw 'em out even when the people involved pass every test of believability.

A Denver woman was intrigued that leukemia deaths so often seemed to run in bunches. She decided to check it out. She plotted children's leukemia deaths in the area, looking for possible patterns. After visiting dozens of homes and talking with the families, she still didn't see any common factors. Then one day the light dawned. In most of the leukemia homes she visited she'd noticed that they had a high tension power line with a pole transformer on it nearby. The power from this transformer was then fed to other houses down the street—the ones with low cancer levels.

I mentioned this in my September editorial. Oddly enough, the several research projects this study eventually triggered, which have supported the concept that power line magnetic fields appear to be causing serious health problems, particularly for children, have met with only lukewarm media coverage.

If, as the studies seem to indicate, we're getting zapped by power line magnetic field radiation, computer display terminals and electric blankets, what can we do about this mess? First, we obviously should panic. That's always a good first step in any emergency. Then what? If you've got one of those big black pole pigs outside your home, should you start packing? If you're working in a data center with a bunch of video terminals, should you start looking for less hazardous work? And should we all turn off our electric blankets and freeze at night like our grandparents used to? Yes, I know, they used wool blankets—a good interim solution.

It seems to me that buying or building a gaussmeter might be a good investment—not only to make sure that your home and work place were magnetic field free, but perhaps to gauss for your friends. With these very weak fields apparently having enough effect on our cells to help cause cancer, leukemia, birth defects, miscarriages and so on, who needs the aggravation?

So let's say you've built a gaussmeter and you find your worst fears are verified—you and your family are being gaussed! Then what? Before moving I'd want to see if it isn't possible to generate a magnetic field to counter the offending one. A few turns of wire around your home and perhaps ten to twenty watts might well balance out even a fairly strong magnetic field from a nearby power line or transformer. Your gaussmeter will tell you the story.

What about the electric blankets? That's going to be tougher. But now that the cat's out of the bag, if I were an electric blanket manufacturer, I would spend whatever it takes for an engineer to design a self-canceling magnetic field blanket. If they run the heating wires in pairs, their fields should cancel and we'll see a jump in the birth rate—just what we need.

This could be catastrophic for the sickness (which we call "health") community—doctors, hospitals, drug companies, undertakers, cemeteries. It could even upset the Social Security system, since it's possible that magnetic currents are causing more deaths than cigarette smoking.

Hmmm, you know, in the old days they oriented houses so they were facing north or south. People preferred to have their beds on a north-south axis. When you consider that the earth's magnetic field is over 500 times as strong as the 60 Hertz fields which are causing us so many health problems, maybe we should check out how cells fare with different compass orientations. Perhaps there was something to this business of sleeping with your head to the north. Probably not, but why takes chances, right? All I know is that once I changed my bed so my head was to the north, I stopped having serious back problems—and that was 25 years ago.

I'll bet the thousands of you who Bashed your way to a ham ticket are kicking yourselves now. Suddenly your neighbors, who before were slashing your tires in retaliation for TVI, now will be turning to their supposed neighborhood electrical genius for help and you don't know bupkis. Let me know how interested you are in our publishing a series of articles on the fundamentals of alternating current and magnetic fields.

We're getting a milligaussmeter for use around the *73* hamshack, the WGE building, and gaussing out our employee homes. We're calling our new company *Gaussbusters*. If you're interested I'll let you know how we make out.

In the meanwhile, read the Feynman book and enjoy it. Then start looking for anomalies and see where they lead you.

If you're able to come up with a simple degaussing system for video monitors and TV sets, and if you market it right, you'll be set to make a mint. The real entrepreneurs already have a month or two head start on you, so you'd better get cracking.

Birthday

As one gets older a birthday is not just a milestone, it's a time for reflection. It's a time to ponder what's been accomplished so far and what may yet be done. At 67, I'm about ten years older than the average ham, so maybe you'll be interested in my perspective—in what you may be facing ten years from now when your 67th birthday comes around.

Being practical about it, how many more years can I count on to be productive? And then what? Sure, some men manage to stay relatively healthy and sharp into their 80s. But not many. So maybe I can hope I'll be able to get in ten more years before I drop dead. I'm in pretty good health—don't smoke or drink—so I should be able to beat the odds, which are around 72 years these days, by five years.

Ten years. Ain't very much, considering my extravagant goals. You know, I get exasperated when I talk with retired hams on the air, men who have spent a lifetime getting good at something and then walk away from their expertise to fritter away what's left of their lives rag-chewing on 75m and playing golf. Phooey.

I've spent a lifetime getting good at publishing, so naturally some of my goals are in that field. I've got a list of ten magazines I want to start—magazines which are needed and will benefit the country. All are unique concepts.

When I took back the position of publisher of *73*, I did it with the hope that through *73* I might be able to help get amateur radio growing again—to again attract youngsters to the hobby and as a result make sure amateur radio would be around for yet another generation or two. Even more important to me was that I see amateur radio as a major resource for providing America with the very best kinds of engineers, technicians and scientists in an age when technology is the key to world power.

As a technician on a submarine during WWII (hmmm, that was 45 years ago!) I saw up close how technology turned the tide in that war. I recognized that as a metaphor for the coming economic world war, which I believed would be next. International business has replaced guns and bombs, and America is losing WWIII.

It's frustrating to see this happening and be relatively helpless to do much about it. It's even more frustrating when I see how much amateur radio has inadvertently contributed to America's losses in this new kind of undeclared war. I see amateur radio atrophying—and with its decay, nailing the coffin of America's hopes for winning WWIII.

We've already lost our consumer electronics industry. We're well along with losing our entertainment industry, our hotels, and even our computer industry. We've lost much of our automotive and clothing industries. Even our publishing industry is being bought out.

We won't win this economic war by putting our bets on megabusinesses—these are much too easy to buy out, as we've been seeing. America's real strength lies in about seven million small businesses, not our Fortune 500.

You know, we've been so dazzled by our military preoccupation with the USSR, that we haven't been watching our economic store. Japan has been able to quietly lop off key chunks of our business anatomy, one after the other, without our seeming to really notice.

Japan, with a fantastic school radio club infrastructure, is running circles around us in engineers and technicians. We killed our school clubs off 25 years ago, as I seem to keep mentioning, and yet which seems to come as an incredible revelation when I give talks at hamfests.

Now, after about three years of trying to interest amateurs or the ham industry in the problem, I've seen so little progress that I find myself looking for fights which seem more winable. Sure, I know some low cost ways of solving our problems—like getting a hundred ham industry companies to ante up $100 each to fund a National Industry Advisory Committee (NIAC) to go to Washington and meet with the new FCC commissioners to help make them aware of what's happened and our proposals for solving this national technology crisis.

Like getting a pilot program into our public schools to teach the fundamentals of electronics, communications and computers to grades 5–12 via a new teaching system which will eliminate the usual need to take ten years to develop new teachers. This could easily bring us an extra 50,000 new hams a year as a bonus. If we expand the program to every state we might end up with millions of new young hams—and finally have some use for the 99.9% of our bands which are virtually unused—and some impetus to develop very-narrow-band voice systems before the Japanese do it.

My educational plan would have the drawback of costing the federal and state governments nothing, so you know it would be fought to the death by our bureaucracy and legislators.

Ditto my plan for solving the welfare

Continued on page 74

QRX . . .

EDITED BY BRYAN HASTINGS NS1B

K6MH is New AP!

73 Magazine proudly announces the arrival of its new Associate Publisher, Jim Morrissett K6MH.

Jim brings much amateur radio magazine publishing experience to the post. He first started at *CQ Magazine* as Associate Editor in 1955, when Wayne Green was the editor. Among his interesting tasks there was a trip to Antarctica in late 1956 and early 1957 to serve as a correspondent for *CQ Magazine*. Later, Jim wore many hats on the staff of *73 Magazine* during its tender beginnings in New York City in the early sixties.

Jim will certainly be a vital influence in the continuing growth of *73*. Welcome aboard, and welcome back!

Boldly Go Up-Frequency

You can go ahead and buy that gear for 450 MHz and above—it now looks like there WON'T be retaliatory trade measures taken against UHF amateur gear imported from Japan (see the August '89 "QRX"). The US earlier charged Japan with maintaining unfair trade barriers, particularly in the cellular phone market. Thus, the US Trade Representatives office planned to impose a 100% duty on 70cm and shorter frequency band mobile communications gear from Japan. Japan, however, has now agreed to open up its cellular market to US firms, negating the purpose of the proposed tariff.

Cool It!

The FCC has three new Commissioners. On 4 August, the Senate confirmed the Executive nomination for Sherrie Marshall, Andrew Barrett, and Alfred Sikes. After Commissioner James Quello swore in Sikes, President Bush designated Sikes as FCC Chairman. Since 1986 Sikes has served as Assistant Secretary of Commerce and Administrator of the National Telecommunications and Information Administration at the Department of Commerce.

1¼ meter users had long been worked up about the nomination of Sherrie Marshall as she has spent the past several months as a partner in the law firm that represents United Parcel Service in the 220–222 MHz reallocation issue. Those folks can now redirect their energies. As it turns out, Ms. Marshall was not with the firm at the time it was retained by UPS, nor has Marshall been involved in the 220 MHz reallocation issue! This is likely why the ARRL, which has been leading a "Save 220" campaign, didn't file any opposition to the Marshall nomination.

Here's one of the many fine Japanese amateur club photos that come across our desks at 73 HQ.

This one was snapped during Erik Orre N6PPD/7J4AAG's 10-month sojourn in Shimonoseki, on Honshu, Japan's main island. Here, Eric poses with a few of the club members of the Chamber of Commerce ham club in the city. N6PPD reports he was treated with the utmost kindness and friendliness during his stay.

So, let's see some more of these from this side of the Pacific! No polaroids please—35mm or better, and color much preferred.

UK Novice

The Radio Society of Great Britain (RSGB) presented its initial proposals for a United Kingdom Novice license level. See the September issue of the Society journal, *Radio Communications*, for details.

VHF/UHF Records Set!

There are four new world VHF/UHF DX records! During 13–15 July, Paul Lieb KH6HME, camping on the Mauna Loa volcano in Hawaii, and Jack Henry XE2GXQ in Baja California, Mexico, broke records for 2m, 1¼m, 70cm, and 13cm amateur contacts. The 2 meter record of 2659 miles was set on July 13 at 10:46 AM HST by Paul, at the Mauna Loa site, in contact with Jack, who is located at Rosarito (about 640 miles south of San Diego). They exchanged a 5 x 2 signal report on SSB. KH6HME was running 80 watts to a pair of 7-element stacked yagis, and the station at XE2GXQ ran 160 watts to a single 18-element "boomer."

They broke the 70cm record the next day, at 3:47 PM HST. The distance was 2573 miles between the two operators. Here, Paul ran 100 watts to an 18-element quagi antenna. A few hours later, this dynamic duo felled the 13cm record! This occurred at 5:54 PM HST, while the 10 watt Hawaiian SSB signal beamed toward the mainland, using four vertically stacked loop yagis.

It took more than a day to break the 1.25m record. Finally, at 7:55 AM HST on 15 July, Jack heard Paul's S-2 FM signal on 223.56 MHz. His radio used only a single 5-element yagi antenna to make the path.

The best conditions for a west coast mainland US to Hawaii path occurred on 14 July, when KH6HME confirmed hearing XE2GXQ, who at the time ran only *one milliwatt* on 144.170 MHz, to make the 2500 mile Pacific path! During the same period, KH6HME also worked numerous other stations from Los Angeles and San Diego.

FAR Scholar Winners

The Foundation for Amateur Radio announced the recipients of 31 scholarships it offered for the 1989–90 academic year. FAR is a non-profit organization representing fifty clubs in Maryland, D.C., and northern Virginia. It is devoted exclusively to the scientific, literary, and educational pursuits that advance the purposes of the Amateur Radio Service.

Winners are: Douglass Claprood KA2KWB, David Hulka KD9UA (two awards), James Weldon N1DFQ, Christopher Glassie AD9Q, Rebecca Beth Knoll N4JST, Robert Popella KA3HIE, Colin Smith KB5BSH, Diane Willeman KE8DJ, Laurie Sandell N2FSO, William Sands KA3FXX, William Baggett AA5DF, Michael Sensor KD3LR, Nathan Willingham KAØUFO, Victoria Gruen KA2VHR, Ross Lepaine WG7I, Jack Porter KCØVX, Amos Faux-Burhans KS3O, Barry Bell KA3PRE, Maurice De Vidts NE3S, David S. Katz N3DKV, Kurt Rupperecht N3EOI, Steven Stewart KB4LUJ, Nathaniel Tarbox KC4AOI, Richard Kordick KEØAS, William Free KC3YO, Douglas Benish N3CXB, Lesley Walker N4FTJ, Douglas Kleeman KA9LWN and David Wright WB9VOZ.

Scholarship applications are open to all amateurs meeting the qualifications and residence requirements of the various award sponsors. To get an application, write to: Foundation for Amateur Radio, 6903 Rhode Island Ave., College Park, MD 20740.

Congratulations to this year's winners!

MORE 1.25m Ham Spectrum?

Endorsement of an entry level code-free amateur license was not the only action taken by the ARRL Board of Directors at their recent meeting. The board also directed its counsel, Chris Imlay N3AKD, to go after new 1¼ meter spectral territory—216–220 MHz—as a secondary status allocation! For this, Imlay will file a Request for Rule Making before the Federal Communications Commission (FCC). Stay tuned here for developments.

Thanks

. . . to *Westlink Report* for contributing to this month's news items. Keep your ham radio-related news items and photos rolling in to *73 Magazine*, WGE Center, Forest Rd., Hancock NH 03449, Attn: QRX. You may also submit text as E-Mail to the Sysop on the 73 BBS, (603) 525-4438, 300/1200 baud, 8 data bits, no parity, and one stop bit.

Number 4 on your Feedback card

FLAVORIG!

80-meter CW transceiver from a Radio Shack transistor radio.

by Michael Jay Geier KB1UM

Breathes there a ham who has never pondered the idea of converting an AM pocket radio to ham use? I doubt it. I remember thinking about transistor radio conversion even as a shortwave listening kid, long before I became licensed. What would it take to get the BBC or Radio Australia out of one of those little gems? Could it be done?

Why Not!

Sure. Pocket radios, even the under $10 variety, are full-fledged superheterodyne receivers with AGC. A lot of the work of receiver design has been done for you! There's a perfectly good IF strip, a detector and an audio amp with enough power to drive the speaker. Sounds like a good start, doesn't it?

Of course, receiving strong local AM broadcasts is much easier than grabbing distant shortwave or amateur signals. In addition to the need for a BFO, overall receiver frequency stability must be made tremendously better.

Divide and Conquer

Pocket radios are designed to be cheap, and the greatest area of compromise is in the front end. Typically, a combination oscillator-mixer is used, and this arrangement is absolutely no good for ham use, because it tends to cause reception of more than one band at once (due to oscillator distortion), and may have birdies. Also, the oscillator is nowhere near stable enough for CW and sideband reception.

You can solve these problems by removing the original front end (usually just one transistor and its associated components), and replacing it with separate oscillator and mixer stages. With FETs and simple toroid coils, it's as easy as pie!

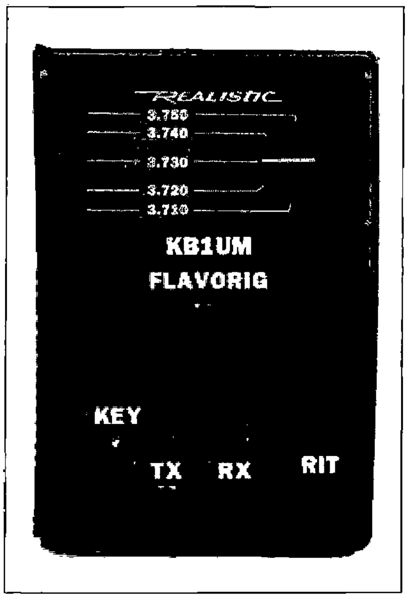


Photo A. Flavorig!

Description of the Transceiver

Flavorig is an 80-meter, Novice band 5 watt CW transceiver, built around a Radio Shack Flavoradio™, which sells for $6.95. It includes an RIT circuit, sidetone, and mini-key, and it operates on 10–14 volts, making it ideal for portable use. As much of the original radio as possible is used. In fact, several parts are REMOVED, with a few being used later, in other circuits. You can buy nearly all the parts at Radio Shack, and the few they don't sell can be ordered from Digi-Key Corporation or Radiokit (see addresses at the end of the article). Initial tune-up requires only another HF rig, an antenna, and a dummy load.

The Flavoradio's single-transistor front end is replaced with two FETs, Q1 and Q7 (see Figure 1). Q1 is an RF amp, whose input is the incoming signal, tuned by L1, mixed with the local oscillator signal provided by Q7. L1, by the way, is the original AM band antenna coil, tuned to the 80 meter band by pulling it part way out on its ferrite rod. The oscillator, used for both receive and transmit, is coupled to the receiver only via proximity, a technique which has several advantages, not the least of which is simplicity!

The IF, detector, and audio stages stay pretty much intact, with only minor changes to increase overall gain and selectivity. The BFO is provided by Q8, which generates a very stable signal by using a ceramic resonator similar to a crystal. The BFO requires no tuning or adjustments.

The transmitter is, of course, not native to the radio. The oscillator signal is shifted to the transmit frequency when the transmit/receive switch is set to transmit. Q9 buffers the signal, and it is coupled via L2 to the Q10 driver stage. L2 is the radio's original oscillator coil, now used as an interstage transformer. Q10 generates enough current to drive the gate of the Q11 final transistor, which provides between 1.5 and 5 watts of output on a 50Ω load. The filter which follows it cleans up the waveform, ensuring spectral purity.

The rig is keyed by providing power to the buffer, driver, and final stages. The oscillator runs continuously. Sidetone is provided by U1, a CMOS 555 timer, which is coupled into the audio amp. In transmit, the receiver is disabled via D4, which cuts off Q1.

Let's Get Started

If you're like me, right now you're thinking, "Oh, no, I hafta wind coils." Well, only two, and they're extremely simple. One has 15 turns of wire, and the other has 30 turns with a tap after the eighth turn. No transformers, bifilar, trifilar, etc. I don't like that stuff either!

After you get the radio and other parts, the first order of business is to remove some parts from the radio. Pop the case open and remove the screws holding the board. Now, refer to the schematic included in the instruction booklet, and unsolder and remove the following parts: C1, R1, R2, Q1, R3, C2, and C3.

Next, remove the oscillator coil, which is the can with the red core. Be sure to unsolder the tabs holding the metal can, as well as the coil pins. The can may come off separately, but that's OK; you can reassemble it, as long as you haven't damaged the delicate coil assembly. Do it carefully, because you'll use it later, in the transmitter! Now, remove R6, R7, and C5.

Take one of the toroids and about four or five feet of #26 enameled wire. Wind 8 turns through the doughnut, then pull out about one inch of wire and twist another inch back on it, to make a tap. Now, wind the other 22 turns. Run your soldering iron up and down the tap with a little solder. Spread the turns so that they go about two-thirds around the toroid. Finally, put some nail polish on the windings to keep them from unraveling.

You've just wound your oscillator coil. That wasn't so bad, was it? While you're at it, you might as well wind the other coil. This one's even easier. Simply wind 15 turns of the same type wire through the other toroid,

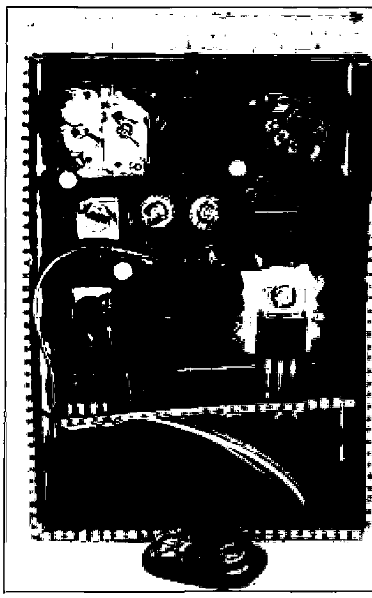
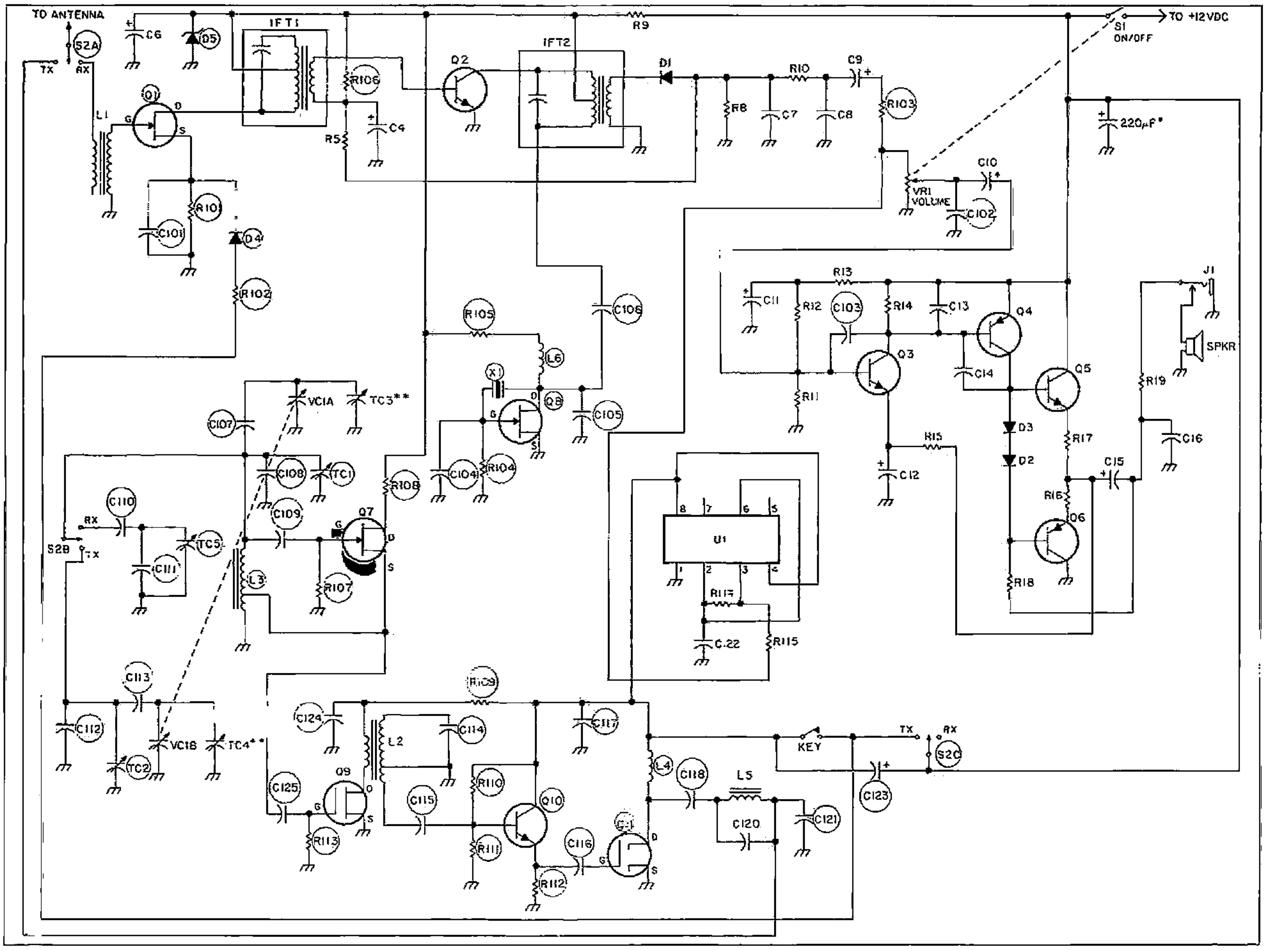


Photo B. Inside Flavorig. This shows the new board (horizontal) attached to Flavoradio's original board.



Schematic for the Flavorig. The internal trimmer of the main tuning capacitor is numbered differently from the original schematic, and there is no part number for the 220 µF capacitor.

Coil Winding Data

- L1: Radio's original antenna coil. Antenna coupling link is 3 turns, any kind of wire, wound over length of L1.
- L3: 30 turns of #26 enameled wire, tapped at 8 turns, on T50-2 toroid.
- L5: 15 turns of #26 enameled wire on T50-2 toroid.

spread the windings two-thirds around, then apply the nail polish.

Now, it's time to start building. First, install a 47kΩ resistor in place of the R6 you removed. Now, stand the oscillator coil on end, and glue it to the board approximately where the old one was, with the glue applied to the area of the coil which has no windings. Run the three wires through pre-existing holes in the board. If there's any slack in the wires, hold them to the board with nail polish, because any movement will cause a frequency change.

If you do some planning, you'll find that you can use most of the traces on the board for the new front end circuit, with a few cuts and jumper wires. Exactly how you lay the circuit out is up to you; it isn't critical. I used the existing holes and traces for the two FETs and the resistors, and soldered the small capacitors and the 6.1 volt zener diode to the foil side of the board, making cuts in the foil as needed.

I recommend mounting the trimcaps on the component side, just below the oscillator coil, to make tune-up easier. It's a tight fit, but it can be done if you mount the oscillator coil up as far as you can. As with any RF circuit, keep component leads as short as possible.

When you've got the oscillator done, look again at the original schematic. Make a foil cut between C9 and VR1 (the volume control), and add a 10kΩ resistor across the cut. Put a 0.01 mF cap from VR1's wiper (the center pin) to ground. Put another 0.01 mF cap between the base and collector of Q3. That completes the changes to the board.

Finishing Construction

You'll need to add a small board to the radio, to hold the BFO and transmitter circuits. I haven't included a PC board design, as most of us don't bother to make one for a single-quantity project. I used simple point-to-point perfboard construction, and glued the new board to the bottom edge of the radio board. Because I like my projects to be compact, I even used the curved space formerly occupied by the speaker magnet!

Wire the BFO and transmitter circuits and attach wires to the appropriate points on the radio. When connecting the transmit/receive switch, keep the wires short, and plan to mount the switch near the IF can with the black core. L2 is the OSC1 coil (with the red core) that you removed earlier. Looking at the coil with the pins down and the tapped side facing you, the ground connection is to the middle pin, and the 0.01 mF cap goes to the pin on the left. Turning the coil around to the untapped side, the FET connects to the pin on the right.

You must heatsink the IRF511 output transistor. Grease it with heatsink compound before attaching the heat sink. If you plan long keydown periods, or extended use at 13.8 volts, consider using a larger heatsink, as the transistor gets quite warm with the one specified.

You must shield the top part of the board, where the VFO and tuning cap sit, because hand capacitance will make it difficult to tune stations if these parts are unshielded. Copper-clad PC board makes a good shielding material. Just be sure to connect it to the rig's ground (the black wire coming from the battery terminals).

Continued on page 88

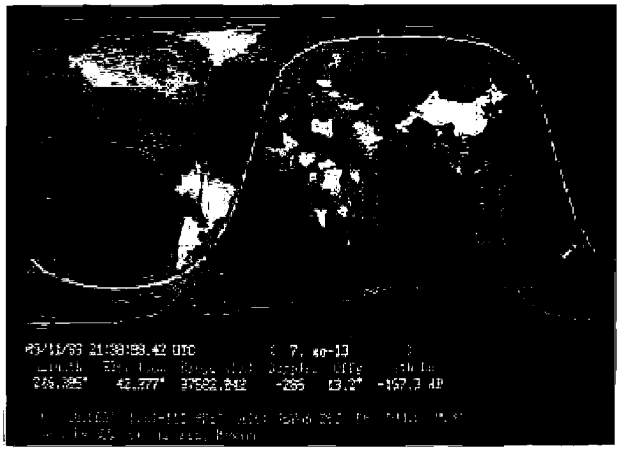
73 Review *by Steven K. Roberts N4RVE*

Instant Track

The slickest tracker yet!

Instant Track
Project OSCAR
PO Box 1136
Los Altos CA 94023-1136
Send an SASE for information.

Instant Track is the creation of Franklin Antonio N6NKF, a project motivated by, as he humbly put it, "a desire to learn something about orbital mechanics." During his year-long education, he produced a piece of code that redefines the state of the art in OSCAR satellite trackers. This PC program dramatically outperforms our government's high-tech satellite tracking tools. This is both exciting and scary: While our taxes buy multimillion dollar dinosaur technology that's already a decade old when it's finally put to use, individual creative hams build systems that run circles around it.



Map display for Instant Tracker.

Instant Track's quality is evident from the moment you bring it up on your screen. The program wakes up with a menu screen that lets you edit your station elements, any of the 200 satellites in its library (it comes with 115 sets of Keplerians already loaded, and tracks them all at once), and gives you a choice of functions. The startup screen even shows the status of your favorite satellites. Without hitting any keys at all you can see if they're up or down.

From here, you can graphically display the world with locations of sun, moon, and your bird of choice continuously updated, invoke a text screen that includes live data for multiple stations (essentially showing Az-El-PA-range data for each), and print a quick-reference operating schedule.

You can also display a massive multiscreen co-visibility grid that shows which satellites can see each other at any given moment (I'm not sure what this is good for, but it's interesting–and hints at just how much number-crunching is going on–inside Instant Track).

One of the first surprises occurs when you tell it your latitude and longitude. I painstakingly determined this from a USGS topo map, keyed it in, and the program correctly said: "1.8 km N of Milpitas, CA," and gave my grid square!

Squint Angle Window

Invoking the map display draws an excellent Mercator projection of the world on the EGA/VGA screen, overlays the sun and its terminator, a dot for the moon, a white X for your station, and a white block for the satellite you have selected from those available (in the selection screen, the ones currently in view are yellow, the others are green—a nice touch). The satellite is surrounded by its footprint, and there's a bonus: For birds such as OSCAR-13 where offpointing angle (squint angle) is an important factor, there's a SECOND footprint (blue) that delineates the portion of the earth's surface within 20 degrees of antenna boresight. This is MUCH more useful than a footprint alone. Any seasoned satellite operator knows that trying to work a bird when the antenna is aiming away from you at 120 degrees is pointless, even if you seem to be right in the middle of a perfect pass.

". . . you can invoke the program and then continue with other tasks while the computer aims your antenna in the background!"

The author took the graphic displays a lot further, making Instant Track as much an educational tool as a tracking system. If you press P while looking at the map, the screen clears and you get a round bird's-eye view of the earth, complete with latitude/longitude reference lines, footprints, and terminator. This display is beautiful, and seems to have become the one I most like to leave on the screen for company. Press P again, and the globe is replaced by an architectural 3-view display of the orbit, including an arrow if antenna orientation is a factor. Press the key again, and this gives way to a "sky view," which places the satellite against the current backdrop of major stars from the observer's viewpoint—helping you visualize where it is.

In any of the four graphic displays, switching between satellites is simply a matter of scrolling with the arrow keys—or popping out to the selection screen, picking a different bird, and dropping back into the map. Fast and easy.

Clearly, the user interface is spectacular, which is one of the reasons it was so dazzling to the pros from the USAF who visited me recently. But there's another side to a satellite tracking program that's all business—pointing antennas. Instant Track does that, of course, and even here there's an unprecedented twist. N6NKF has embedded all tracking functions in a TSR (terminate and stay resident), meaning that you can invoke the program and then continue with other tasks while the computer aims your antenna in the background! In my case, running the Microsats bicycle mobile, this feature will allow the DOS system to generate a message to the FORTH machine whenever any bird of interest comes into view, prompting it to turn on the station and attempt to connect.

System requirements for this tour-de-force of satellite software are as you would expect: You will get optimum performance on an AT-class machine with coprocessor and EGA or VGA display. But it will work, though more slowly and with less pizzazz, either without the math chip or on a vanilla XT.

Do I recommend it? In the month I've had Instant Track I have had no reason to fire up any of the other satellite software in the system. It has become the star of my demo repertoire, and makes scheduling OSCAR operation easy and pleasant. See you on the bird! 73

Steven K. Roberts N4RVE, author of Computing Across America and features in 73 Magazine, *can be reached at PO Box 2390, Santa Cruz CA 95063. He now publishes the bi-monthly Journal of Hi-Tech Nomadness (subscription $15/year.)*

HAM PROFILES

There are no "average" hams!

NYC Ham of the Year

Three years of hard work paid off for Nickol Santiago KB2GGW, age 15, the 1989/1990 Big Apple Ham of the Year. Nickol is known by countless hams around the country for her outstanding operating skills on the WB2JKJ 21.395 MHz Classroom Net sponsored by the Radio Club of Junior High School 22 in New York City, directed by Joe Fairclough WB2JKJ. She took to the airwaves in 1986 as a member of the "Education Thru Communication" class sponsored by the J22 club. "From the first day in Mr. Fairclough's class, I loved ham radio and wanted to get my own license." said Nickol.

As a finalist in the race, Nickol was invited to attend the Knoxville, Tennessee Hamfest on May 19th. Not only did she go, along with WB2JKJ, but she also got to state her views on ham radio from a young person's angle at a well-attended forum. Next up for Nickol was a trip to the Huntsville Hamfest and a week in Tennessee, thanks to the "ET (East Tennessee) Crew at 22" support group led by Carol Whetstone N4LFR.

Nickol Santiago KB2GGW examines her 1989 NYC Ham of the Year award with Joe Fairclough WB2JKJ, president of the Radio Club of JHS 22.

Nickol graduated this June from JHS 22, where she was active in ham radio and in the Legal Studies program. She is now in the 10th grade at Seward Park High School in New York City. She hopes to start a ham radio club there, using the resources of JHS 22. Nickol also works part-time in a bridal shop.

Extra Young Extra Class

Bill Crossley WK2X, age 14, is a ninth grader at the Frewsburg, New York, Central School. Both his father (John N2HBI) and his grandfather (Albert K2EHJ) are amateur radio operators. John is the president of the Chautauqua County Amateur FM Association.

Bill got his Novice license at age 11, after taking Jack Nord AC2D's evening course at the Jamestown, New York, High School. Thirteen months later he earned his Extra license.

Bill has spoken on amateur radio at a local Kiwanis Club meeting, and he is often introduced at Jack Nord's radio classes.

Besides amateur radio, Bill's interests are coin collecting and hunting. He will be taking the Hunters' Safety Course this autumn. He is also a member of his school's Spanish Club. 73

Bill Crossley WK2X—an Extra already!

FEEDBACK

In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers, which appear on each article/column and are also listed here. These numbers correspond to those on the feedback card opposite this page. On the card, please check the box which honestly represents your opinion of each article or column.

Do we really read the feedback cards? You bet! The results are tabulated each month, and the editors take a good, hard look at what you do and don't like. To show our appreciation, we draw one feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*.

To save on postage, why not fill out the Product Report card and the Feedback card and put them in an envelope? Toss in a damning or praising letter to the editor while you're at it. You can also enter your QSL in our QSL of the Month contest. All for the low, low price of 25 cents!

SECOND PLACE
Home Brew IV Contest

The BitChaser

Digital counterpart to the oscilloscope.

by R.A. Cole K4OND

Digital devices and circuits are securing their foothold in the ham world, as well as in many household appliances. Whether you experiment, or repair your own gear, you quickly find that digital devices have their own requirements for test equipment.

While there's no substitute for a good o'scope for looking at repeating waveforms (whether analog or digital), scopes are almost useless for observing one-of-a-kind, short pulses typical of digital controls and signaling. At best, a good, triggered scope tells you a pulse occurred, and gives a brief image of its duration, but the image is quickly gone. An expensive storage scope will tell you a lot more, but it's pretty hard to justify on most ham budgets. Logic probes are cheap and easy to build, but they tell you almost nothing except that there was (or was not) some activity.

Many Uses!

You can use the BitChaser for digital signals, however, almost anywhere an oscilloscope is used, with the bonus that you can store the results as long as desired. Examples are many and varied—you can check the timing and structure of data characters coming out of a modem, RTTY demodulator, computer, keyboard, or packet interface; calibrate the speed and weight on an electronic keyer; track down and analyze spurious pulses in any kind of logic circuitry (much better than with a logic probe!); and check the "handshaking"(protocol agreement) between two digital devices (computer/printer, computer/modem, etc.). You can also use the BitChaser as a signal source, to generate 5, 7, or 8-bit TTY characters at any speed from 60 wpm to 9600 baud and higher. You can use it as a general purpose square-wave signal generator from sub-audio to 4 MHz. You can even use it as a crystal calibrator for the HF bands. With the optional "hidden" 96-bit shift register, you can use it as an RTTY or CW callsign generator.

BitChaser would be useful for checking out two recent *73* projects: "Control Your Rig from a PC" (August 89) and "Kaboom Micro Keyer" (September 89). In the first case, the project involves a computer-receiver interface with handshaking; the second involves using the BitChaser to calibrate the speed control on the Micro Keyer.

Digital Requirements

A major feature of a digital measuring device is that, since we do not have to be concerned with voltage levels other than 0 or +5 volts, we can use a simple display scheme instead of a complex and expensive cathode ray tube.

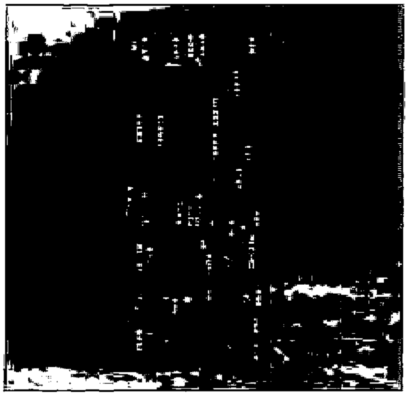


Photo A. Front panel of the BitChaser. The author used a junked Heathkit FET VOM case.

The BitChaser (BC) originally started out as a very simple device for capturing, freezing, displaying, and measuring pulses of almost any reasonable duration and repetition rate. After I finished the basic design, I soon found that a few simple and cheap additions would greatly increase the unit's functionality. For ten more dollars, I modified the BC into an incredibly versatile piece of test equipment, having the following capabilities:

- capture and display pulses from about half a microsecond up to several seconds;
- measure pulse length (duration) and duty cycle;
- measure time between successive pulses; (since this is the reciprocal of frequency when pulses are regular, it performs like a frequency counter, with a little math);
- synchronize the start of capture to the incoming signal (like a triggered scope), or from a separate external signal, or manually;
- stop the capture automatically, under control of a second signal, or manually;
- recycle, as much as desired, captured data for review, or for playback to some external device (which can't be done at all on a scope!);
- measure the time difference between a pulse on one line and that on another (something like a dual-beam scope);
- be programmed with any desired bit pattern, that then can be played back as a repeating signal source (as the RY generators in the Baudot TTY days), and;
- be used, with the internal clock brought out, as a variable or calibrated timing source for general purpose testing.

Thus, the BC is a combination of storage scope, frequency counter, bit-pattern generator, and logic probe. With a little external circuitry, you can even display CW visually. (Those blinking lights will fascinate shack visitors!)

How It Works

Figure 1(a) illustrates the basic idea of the unit. The BC uses a long serial-in/parallel-out shift register, with a discrete LED attached to each stage to display the contents. The clock (time base) performs the shift-right function, so that the signal coming in on the serial-in connection will be sampled and shifted into the register for display. With a clock period much shorter than the duration of the incoming pulses, each pulse will result in several samples of each pulse shifting into the register, lighting the respective LEDs. That is, if the clock period is one microsecond, an incoming pulse of 10 microseconds duration will light 10 LEDs, etc. The "0" levels between the pulses will result in the respective LED remaining off.

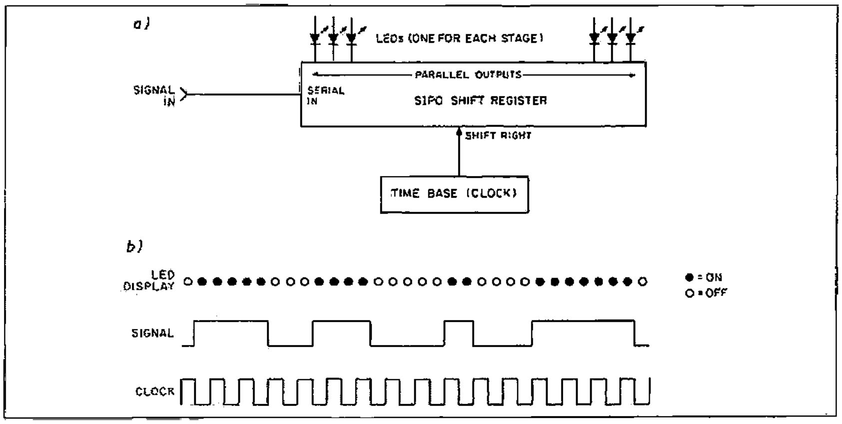


Figure 1. (a) Basic concept of function of LED signal display; (b) example display.

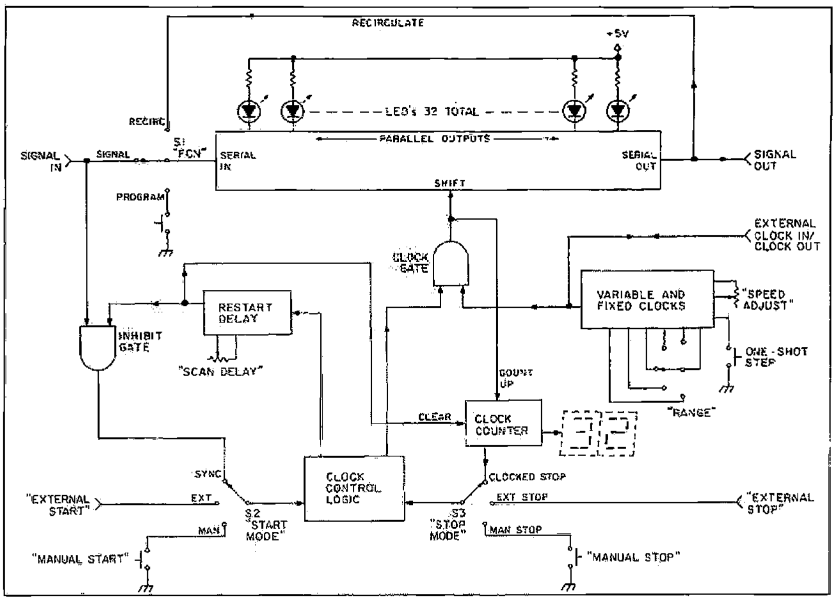


Figure 2. BitChaser block diagram.

Figure 1(b) shows a typical display for an incoming stream of pulses. While almost any display length is possible with this basic scheme, the unit described here uses a shift register and display screen of 32 bits as a compromise between adequacy of display and cost. You may decide to build a different length, although displays much shorter may not be very useful. This simplified circuit illustrates the concept, but suffers from exactly the same frustrating problem of the scope—unless you have a way to stop the clock, the display vanishes.

The Basic Design

Figure 2 is the expanded block diagram. The most important addition is that of "gating" for the clock, by sampling the incoming signal line. I termed this Synchronous Start Mode, analogous to a triggered sweep scope. With this feature, the BC sits and waits for an incoming pulse, then begins shifting the register. The clock counter counts the number of clock pulses, and stops the clock after 32 shifts, thereby freezing the display (Clocked Stop Mode). Once the clock gate circuit had been designed for the Synchronous Start Mode, it was trivial to add a switch and an input jack to allow opening the clock gate with an external signal, or by a manual push button, and to close the gate the same way. The Start Mode and Stop Mode switches, respectively, select these functions.

Note that the mode selections are totally independent. You can have a Manual Start and Clocked Stop, or any other combination that suits your purposes. The External Start and Stop connectors are useful to allow you to measure the time relationships between signals on two different lines. One is used as the signal, and the other as the External Start or Stop. The display measures the time between a negative-going pulse on the Start line and the next positive level on the Signal line.

The main use of the above feature is to observe the handshaking between two devices, like a computer and a printer, to see if one device is responding correctly to the other. For example, I had troubles with a printer omitting one or two characters at the end of a line. This turned out to be a timing problem during the carriage return—the "not-ready" signal from the printer was being ignored by the computer. This required an extra testing loop in the printer driver software to detect the "not-ready" condition.

A crystal-controlled oscillator and divider chain provide the main clock signal. These allow for precise measurements of pulse width by having a known time interval for each LED. (Analogous to calibrated time/division on a scope.) The circuit as shown provides time-per-LED periods of 0.25, 0.5, 1.0, 10.0 and 100 microseconds, and 1.0 or 10.0 milliseconds. Since the display is 32 LEDs long, this results in displays of 8, 16, 32, 320 and 3200 microseconds, or 32 or 320 milliseconds, respectively, of activity on the signal line.

Low resolution of the LED display limits

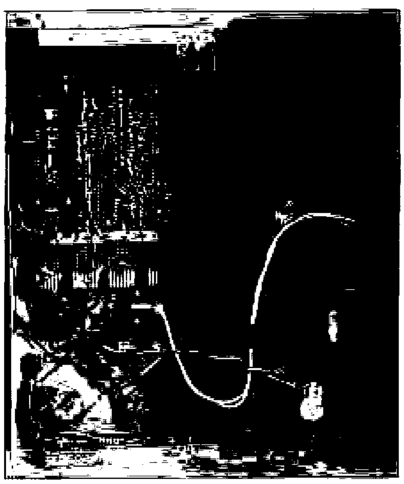


Photo B. Internal view of the BitChaser.

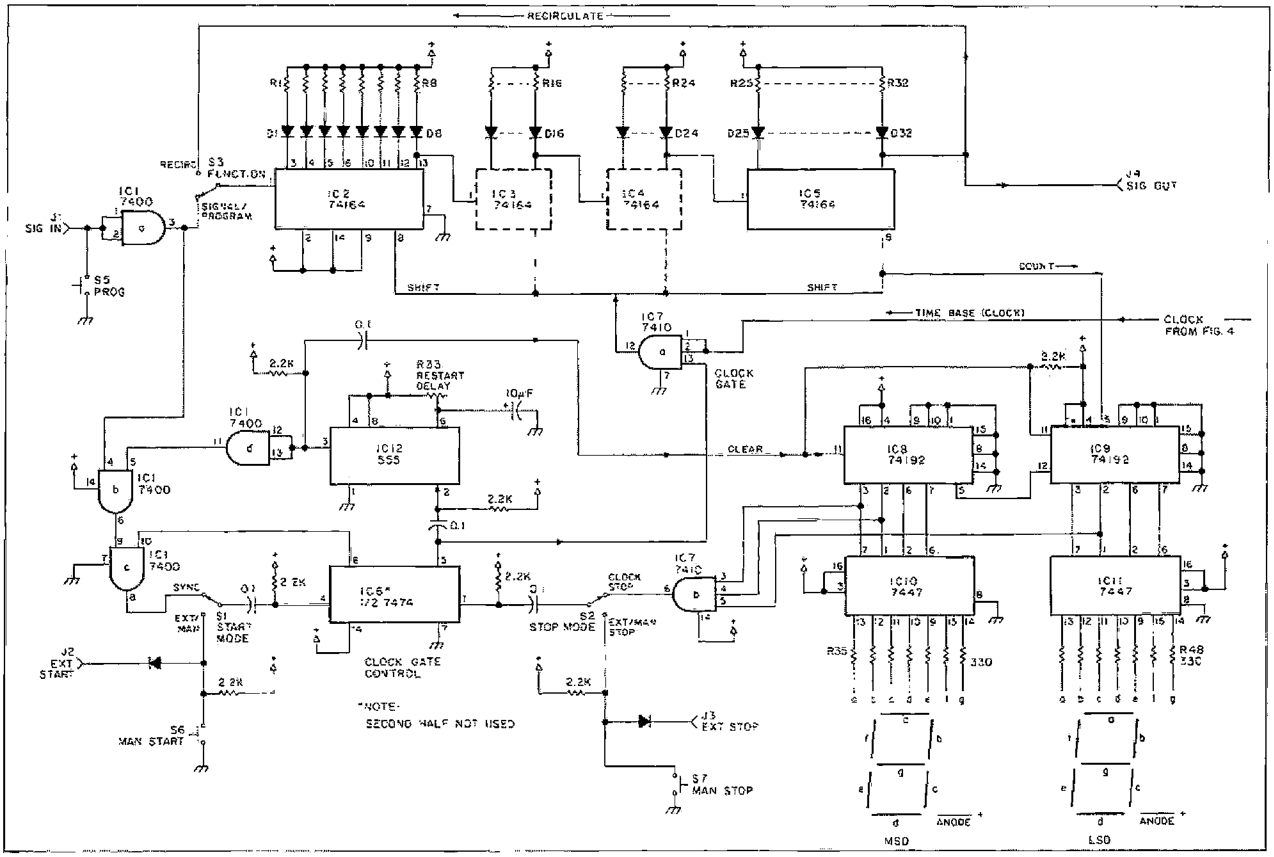


Figure 3. Shift register, display, and control circuitry.

precise measurement of pulse duration; a pulse duration of, say, 2.3 milliseconds would show up as either 2 or 3 milliseconds when using the 1.0 milliseconds-per-LED range. You can increase accuracy by shifting to a faster clock speed, provided the duration doesn't exceed total display length.

To increase flexibility when not much is known about the duration, timing, etc., of the signal source, I included a variable clock. This works much like the variable time/division adjustment on an oscilloscope.

Since you bring the clock out to an external jack, if you have a frequency counter, you can monitor the variable clock and determine the LED interval quite precisely.

With this basic practical design, you have an instrument that will allow you to capture pulses, freeze them, and measure their lengths, separations, etc., in a fairly automatic way, and represents the prime operating mode of the BC.

Modifications

A few more components greatly increase utility. The Restart Delay is a simple timer circuit that freezes the display for up to about 10 seconds, then re-activates the Synchronized Start mode for another sweep. In the Sync Start mode, the Restart Delay also prevents another pulse on the signal line from accidentally re-triggering the shift registers before you are ready. The 7-segment displays attached to the clock counters are useful at slow speeds (or when programming the display, as explained later), and they add very little to the cost, since the counters were necessary to create the Clocked Stop mode. The display freezes (after 32 periods), then resets to "00" when the Restart Delay times out. Thus, if the BC is just sitting there with the display showing "00," you know it is ready but no pulse has arrived.

Another nice-to-have addition was a programming push button switch, along with a one-shot clock. These allow you to enter any bit pattern into the shift register by holding down (or releasing) the Program button, and firing the one-shot clock. (You could just use a very slow clock along with the Programming button, but once you start programming that way, you can't stop until you are through!) Anything that will fit into 32 bits can be programmed; this includes several ASCII or Baudot characters, eight-bit data characters, or a couple of Morse characters (not a full callsign, though!). The bit pattern, whatever it is, can be sent out once, at any data rate available from the crystal or variable clocks, or it may be repeated as many times as desired by using the Recirculate feature.

Notice that although the shift register acts like a serial-in/parallel-out register, all of the contents come out serially, also! Thus, once a bit pattern has been captured by, or programmed into, the shift register, you can switch to the Recirculate mode, and recycle the bits back into the input of the shift register, at the same time that you output them to some external device. You can even change the time base during recycle, to repeat the same bit sequence at a slower or faster rate! This is useful, for example, in testing a printer or some other serial communications device with unknown speed capability-just send data at varying rates until it syncs and performs properly.

Shift Register and Control Circuits

All of the circuits are simple, non-critical TTL logic, with easy-to-find parts. The shift registers are 74164 8-bit serial-in/parallel-out registers; four of them are required to reach the 32-bit desired length (you can use as many as you want, though). 7400 NAND gates do most of the on/off gating of the various signal paths, and a couple of inversions.

Note that the input signal is inverted before it goes to the first shift register; this is because the LEDs are used in a pull-down mode, which requires the respective register position to contain a "0" to light the LED. Since I wanted the LED on for a high logic level, and off for low, the simple answer was to invert the signal, so that a high on the incoming line results in a low inside the register.

The clock gate (IC7a) is controlled by a 7474 flip-flop (IC6) in set-reset mode. The clock gate is opened by a high-to-low transition from either the signal (Sync Start), by an external, separate signal (Ext Start) or the manual push button (Manual Start). The opposite output of the 7474, which will be "0"

when the count gate side is at "1," turns off the incoming trigger line by IC1c, to inhibit unwanted trigger pulses.

IC8 and IC9 perform the clock counting function, with IC7b decoding the count of 32 and providing the Clocked Stop signal to IC6, closing the clock gate, IC7a. You may also close the gate with an external signal or the manual push button. No matter how the stop is generated, the high-to-low transition of the clock gating signal (pin 5 of IC6) also fires the Scan Delay timer, IC12.

IC1d inverts the high level output of IC12 and turns off IC1b, again preventing any incoming signals from triggering IC6. When the timer times out, up to about 10 seconds later as set by R33, its output goes low, opening up IC1b again, and also resetting the clock counters, IC8 and IC9, to zero. (Note that the counters are cleared by parallel loading all zeros into the counters' preset inputs, not by using the normal clear function. This is because the clear requires a high pulse, and none is readily available at just the right time. The parallel load operation requires a low pulse, which is available.)

Time Base Circuits

See Figure 4. The clock is a straightforward crystal oscillator and divider circuits. I chose a 4.00 MHz crystal to give a 0.25 microsecond speed, then divided by 2 in IC14a for 0.5 microseconds; then again by 2 (IC14b) for the 1.0 microsecond rate. I followed this with a series of divide-by-ten counters to get speeds down to 10 milliseconds. Thus, at the fastest speed, the LEDs display 8 microseconds of signal activity (32 x 0.25 microseconds), and at the slowest speed, 320 milliseconds of activity.

You can start with a lower crystal frequency if you think you will not be going after pulse widths less than a microsecond, and possibly eliminate IC14a and b. You can also eliminate one or more of the decade dividers if you don't need the longest pulse width measurements. I do not recommend crystal frequencies higher than 4 MHz, unless you are willing to play around with the values of pull-up and coupling capacitors in the clock gate control areas.

The variable clock is one-half of a 556 dual timer in astable mode. With the three ranges and values shown, it will run from about 100 kHz (32 milliseconds of signal activity displayed) down to about 1 Hz (32 seconds of signal). The other half of the 556 dual timer (IC19) is the one-shot timer for single-stepping (e.g., during programming).

Construction

You can use just about any board layout and panel design. The circuits are non-critical at the relatively slow clocking speeds involved. You may have to play around with the crystal oscillator resistors and capacitor values to get reliable starting. You may also have to adjust the values of C1, C2 and C3 in the variable time base, IC19, to get continuous frequency coverage. (You can also add a couple of switch positions and capacitor values, if necessary.)

I made a few more shortcuts to hold down costs and save panel space. Notice that S1, S2, and S3 are SPDT toggle switches, even though they all have three positions. This is because one position can be common between two functions, with a little care. For example, S1 (Start Mode) uses a single position for either External or Manual Start; the diode protects an external signal source from short-circuit if the Manual button is pressed while still connected. The same holds for S2. S3 uses a common position for the Signal and Program functions; the protective diodes were considered unnecessary in this case. You can easily substitute three-position rotary switches, and omit the diodes.

S4, the Time Base Select, uses a similar trick to allow a single jack to be used for either the Internal Clock Out, or External Clock In; the extra switch position just assures that the internal clock will be disconnected when an external time base is used.

LED string assembly is the only construction that needs special care. Use sub-miniature LEDs, not miniature or jumbo sizes. The 32 diodes take up about 4 inches of space in a horizontal line. The subminiature LEDs are just a little too large in diameter to mount them in adjacent holes in the PC board, so grind or file off the opposite sides of the plastic bulb, being careful not to grind down to the actual LED in the center. I ground mine down with a Dremel tool. Each diode takes only a few strokes with a fine-tooth file.

The 10-LED Bar Graph displays (RS 276-081, at $2.99 each) produces the most attractive display with no hassles. If you go this route, you will either have to shorten the display to 30 bits (i.e., 3-bar graph chips),

continued on p. 48

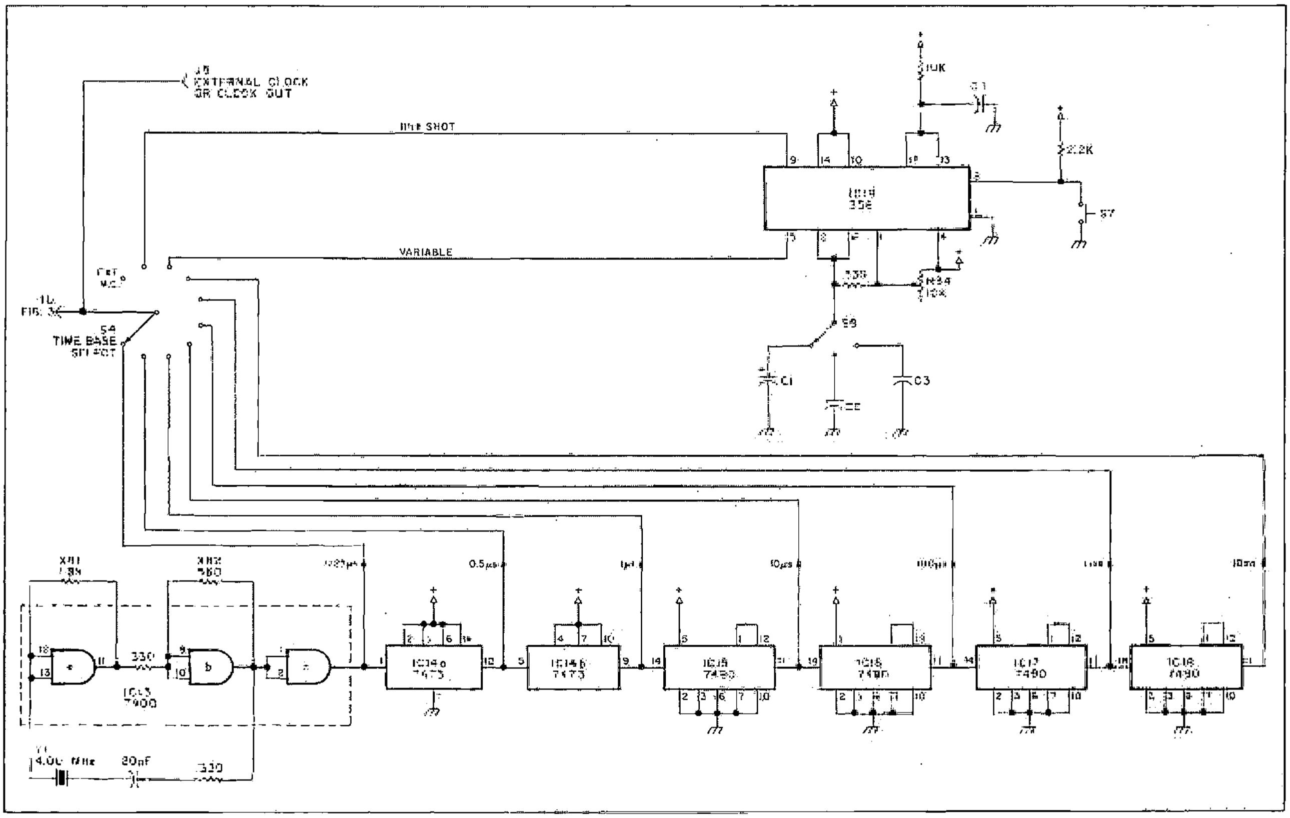


Figure 4. Time base circuitry.

73 Review *by Jim Gray W1XU*

Yaesu FRG-9600 VHF/UHF Receiver

Awesome frequency and memory coverage in a VHF/UHF scanner receiver.

Yaesu USA
17210 Edwards Rd.
Cerritos, CA 90701
(213) 404-2700
Price Class: $610

Have you wondered what goes on in the VHF/UHF portion of the radio spectrum? You've probably worked some 2 meter FM and maybe some 440 MHz stuff—but there's a lot that goes on in the world between HF and microwaves. For instance, from my location, I can tune into a series of high-flying, radar-equipped balloons used to interdict low-flying drug trafficking aircraft, stretching from Texas to California. This activity is on frequencies assigned to the Drug Enforcement Agency (DEA). Frequencies for various other goverment agencies, including the FBI and the CIA, also abound in this large piece of spectrum.

Search For The Scanner

As it turns out, there are a number of multi-mode scanning receivers that cover this wide range. I asked knowledgeable friends and fellow hams about these various receivers: "How is the audio quality? What coverage does it have? How many different modes will it handle? Is it mobile/portable? How are the selectivity and the sensitivity? What are the scanning capabilities?"

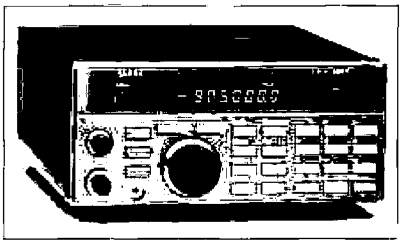
For those who can afford it, the ICOM R-7000 and the R-9000 rigs may well be the way to go. I wanted something under $750, however, and found that the Yaesu FRG-9600 answers most favorably to all my questions above.

Spectacular Coverage

The 9600, in brief, is a multi-mode scanner covering 60 MHz through 905 MHz continuously. One feature that quickly impressed me was its keypad with 100 programmable memory channels. It may well be overkill to have this many memory channels on an HF rig covering under 30 MHz, but not so for the 9600, which accesses a chunk of spectrum over 840 MHz wide!

The 9600 doesn't have *all* available signal modes, but its six mode selections—FM and AM, each both narrow and wide, and SSB, both LSB and USB—will do nicely for most of the signals you'll encounter there. You can find ham communications here in all of these modes, but NBFM ("FM-narrow") is the most popular.

"FM wide" is used mainly for FM broad-



casts (88–108 MHz), TV broadcasts, (scattered throughout much of the spectrum covered by the 9600), and cellular telephone transmissions (between 800–900 MHz). Be warned, however, that it is *illegal* to monitor cellular telephone activity! The 9600, unlike some other scanners of this range, does not block all these frequencies.

"FM narrow" is the standard mode for two-way police, military, business, and amateur communications. The ham bands the 9600 covers are 2m, 1.25m, 70cm, and the bottom three MHz of 33cm (902–905 MHz).

AM wide and narrow are used mainly for aeronautical communications, and some amateur work. You can find some aeronautical communications from 118–136 MHz and 250–300 MHz.

The FRG-9600 provides single sideband (SSB) reception up to 460 MHz. This covers amateur weak-signal work—typically voice SSB and CW—on all the above stated ham bands except 33cm. There's quite a bit of exciting weak-signal stuff to hear, including CW signals reflected off of ion trails left by meteors entering our atmosphere, and amateur satellite SSB and CW downlinked signals. The military also uses SSB in these regions.

The only drawback I spotted was that a desired mode—selected by a single control—can't be selected out of order. That is, in the mode-select order LSB, USB, AM-N, AM-W, FM-N, FM-W. If you are currently in USB and want to go to the other sideband, you have to step through the four AM and FM mode settings before getting to LSB. The upside, though, is that this system removes five extra controls from the front panel.

Quickly Accessing It All

The 9600 of course has a front-panel VFO control, but when dealing with such a vast piece of spectrum, it's MUCH easier to dial in a desired frequency from the keypad. Yaesu thankfully provided that here. They also didn't stint on the number of selectable tuning steps. FM-W allows 100 kHz tuning steps, while AM-W and FM-N allows for 5, 10, 12.5, and 25 kHz steps. Both AM-N and SSB allow 100 Hz and 1 kHz steps.

The scanning system allows either full or limited (keypad programmed) band scanning, as well as memory channel scanning, with auto-resume. Besides carrier-sensing scan stop, you can also select audio scan stop sensing to avoid stopping on "carrier-only" channels. I found that this feature works very well, and is very useful. You will be amazed to find so many of these carrier-only broadcasts throughout the spectrum—yet never hear any audio transmissions on them. Possible sources for these "broadcasts" may simply be harmonics of a TV or other broadcast, or deliberate jamming of a channel by an assigned user to prevent the channel from being used by someone else, as on HF foreign broadcast bands.

Scanning steps are displayed on the front panel. A two-color graphic S-meter on the display indicates received signal strength. A 24-hour clock timer is also included, along with a output for automatic power "On/Off" switching for recording transmissions automatically. Additional jacks provide CPU band selection outputs for remote computer control of the receiver, as well as multiplexed (FM wide) AF and RF mute and other control signals. There's also a mobile mounting bracket.

Patch it to Your PC

Many newer transceivers have a data port that allows you to interface a rig to a computer and control many of the functions from that computer. Yaesu calls their system the Computer Aided Tuning (CAT) System, and have included it on the FRG-9600 in addition to many of their base and mobile transceivers and HTs. This allows direct control of the rig's CPU, allowing you to add virtually unlimited customized control functions in software,

such as multiple organized memory banks, auto tuning, and customized scanning systems—using almost any personal computer and a Yaesu FIF CAT interface Unit (available as an option). So far, I know of no prepared terminal software for this. Engineering Consulting in Brea CA (714-671-2009), and Data-Comm, Int. in Hollywood FL (305-987-9505), however, have long worked on software for the CAT system in other Yaesu rigs, and may have something developed for the 9600.

I haven't yet tried CPU control because I don't have the CPU control interface—but I'm considering one for my laptop computer for an extraordinarily versatile and compact system. Both operate from 12 VDC, making it a good combo for portable/mobile use.

Options

Somewhat surprisingly, the AC adaptor (PA-4) is an option. The rig does come with a DC cable with a connector that plugs into the 9600's back panel. Be sure to read the manual so as to not confuse the positive and negative leads.

A TV video IF unit is also available as an option allowing reception of TV pictures (NTSC format) with a video monitor connected to the video jack on the rear panel.

Documentation

The 40-page instruction manual that comes with the FRG-9600 receiver is complete and comprehensive. The text is easily understood; it was either written in English, or expertly translated from Japanese. Also, all photos, charts, and figures are easily readable.

Unexpected Use

I have enjoyed listening to communications which include police, fire, sheriff, military, forest service, airline, government—and, of course, lots of FM broadcasts. One useful application I never expected was a "clean and correct emission verifier" on the 72 MHz radio-control bands for a major model sailplane contest. In this event, last May in Washington State, the 9600 monitored the radio control frequencies for interference and checked each R/C transmitter for output on the proper channels for 125 model sailplanes. No planes were lost due to interference!

Specifications

Frequency Range:	60–905 MHz (up to 460 MHz for SSB)	
Modes, 3dB Bandwidth:	FM Narrow	15 kHz BW
	FM Wide	180 kHz BW
	AM Narrow	2.4 kHz BW
	AM Wide	6 kHz BW
	SSB	2.4 kHz BW
Conversion Schemes:	Triple (FM-N, AM, SSB)	
	Double (FM-W)	
	Single (Optional TV Video Unit)	
Intermediate Frequencies:	45.754, 10.7 MHz, and 455 kHz	
Image Rejection:	60–460 MHz	−50dB typical
	460–905 MHz	−40dB typical
Typical Sensitivity:	FM-N	0.5μV (for 12dB SINAD)
	FM-W	1.0μV (for 12dB SINAD)
	AM-N	1.0μV (for 10dB S+N/N)
	AM-W	1.5μV (for 10dB S+N/N)
	SSB	1.0μV (for 15dB S+N/N)
Tuning Steps:	FM-N*	5 / 10 / 12.5 / 25 kHz
	FM-W	100 kHz
	AM-N	100 Hz/ 1 kHz
	AM-W*	5 / 10 / 12.5 / 25 kHz
	SSB	100 Hz / 1 kHz

*Selected steps shown on display.

Memory Channels:	100	
Audio Output:	1W (into 8Ω, with less than 10% THD)	
Power Supply voltage:	DC 12–15V	
Power Supply current:	Operating	550 mA (maximum)
	Power Switch off	100 mA
	DC Supply off	3 μA max. (backup)
Case Size (W x H x D):	180 x 80 x 220 (mm)	
Weight:	2.2 kg (4.9 lb.) without options	
Supplied Accessories:	Whip antenna (0.6m)	
	DC Power Cord (1.8m)	
	MMB-28 Mobile Mounting Bracket	
	Wire Stand	
Options:	AC-DC Wall Adapter (PA-4B for 110–120V, or PA-4C for 220–240V)	
	Video Unit (NTSC)	
	SP-55 External Speaker	

Bringing Back The Memories

The FRG-9600 memories are arranged in ten banks of ten memories each. You can program each decade with its own mode/bandwidth combo. I find this very useful—one decade contains frequencies for FM broadcast stations around the state, another contains frequencies for the local police, fire, sheriff, forest service and EMT/med-Evac frequencies, and a third decade contains aircraft and air route traffic control frequencies. A fourth decade contains military aircraft air-to-air and air-to-ground frequencies. (In Arizona there is a lot of military aircraft communication on an almost round-the-clock basis.) If I wished, I could put in FBI, Treasury Department, CIA and other frequencies, in a new fifth decade. That still leaves another 50 memories.

Antenna

The telescoping and swiveling whip antenna that comes with the receiver is 23″ long fully extended, and attaches to the receiver via a PL-259/SO-238 connection. This antenna does quite well, considering its size. If you live in an RF-rich environment, such as an urban area, you may find this antenna not only adequate, but even preferable to one with more gain, so as to reduce front-end overload. When you start getting into UHF, however, I suggest you use a matched antenna located high and in the clear, connected with low-loss hardline coaxial cable—just as you would if you were using a transmitter. Of course, you can use the FRG-9600 as a separate receiver in connection with a transceiver covering roughly the same frequencies.

The only nit-pick here is the chassis connector used. For serious VHF and UHF work, an N-type connector is a better choice.

An "A" for Audio

In my opinion, this receiver provides audio quality as good as, or better than, many other receivers I've used. Although there is a built-in 2-½″ speaker in the top of the cabinet, I prefer an external speaker of good quality for personal listening on FM broadcast. If you wish, you can also use the built-in jack for earphones in high ambient noise levels.

Conclusion

In sum, the FRG-9600 is a rugged, compact, high-quality communications receiver with versatile scanning capabilities. It represents very good value for the money, and I recommend it to interested VHF and above band scanners without hesitation.

The author wishes to thank Universal Shortwave Radio from whom the receiver was obtained for testing. I have just become another satisfied customer! 73

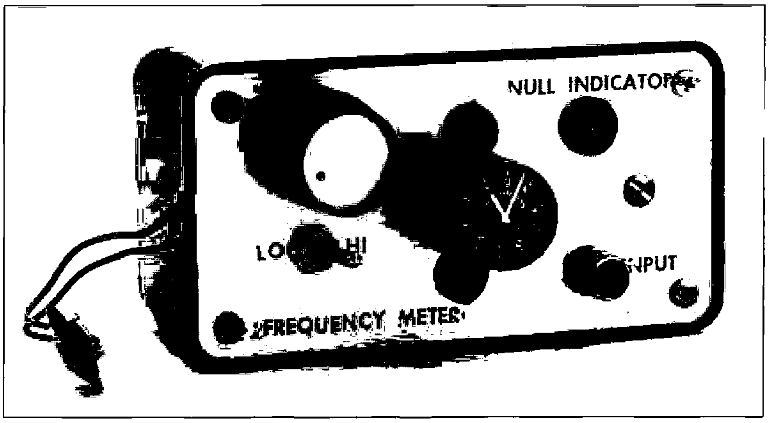
Jim Gray W1XU, 210 Chateau Circle, Payson, Arizona 85541, has been 73's Propagation columnist since 1984. He's been a ham for 39 years, and likes to operate CW on WARC bands 12, 17, and 30. He's also interested in aviation and photography.

THIRD PLACE
Home Brew IV Contest

Bargain Audio Frequency Meter

Build this vital addition to your test equipment bench for about $10.

by William Lazure KB5CTH



If you like construction projects, you need a stable and sensitive audio frequency meter. If you are a ham, chances are you'd like to get this meter as inexpensively as possible. The following project meets both criteria. If you purchase all the parts new, the entire project costs about seven dollars. The device gives a fairly sensitive reading from 60 Hz to 100 kHz.

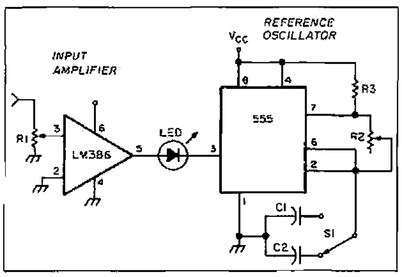
How It Works

The meter is actually a frequency comparator much like a BFO. The input frequency is amplified and applied to one side of the indicating element (a simple LED). An internally generated frequency is applied to the other side of the LED. When the internal oscillator is equal in frequency and phase to the incoming signal, the LED goes out. You read the frequency of the internal oscillator off of the potentiometer that varies the frequency of the internal oscillator.

The internal oscillator is just an NE555 timer/oscillator IC wired for the astable mode. S1 switches one of the range capacitors in and R2 varies the frequency through that range. Low range (C1) covers about 60 Hz to 3 kHz, and high range (C2) goes from 2500 Hz to 130 kHz. The output of this oscillator is a square wave of about 3–5 volts.

The input signal goes through R1, which sets the input amplitude to the amplifier. The amplifier IC is an LM386 programmed for a gain of 20 (pins 1 and 8 are open). There is no coupling capacitor on the output of the amp because the amplified signal is automatically set at half of supply voltage by the amp. We need this signal to be biased above ground to match the output of the internal oscillator, which is also biased above ground. You can use almost any type of LED, since both active elements are capable of sinking or sourcing up to 200 mA. The current drain is quite low, so the use of a battery is sufficient. The voltage of the battery doesn't have to be exact because the 555 shows a constant frequency over a wide range of supply voltage.

Construction is not critical. The timing capacitors can be ceramic, Mylar™, greencaps, or any combination. However, the 100k pot (R1) must have a linear, not an audio, taper. When a pot has an audio taper, the upper frequencies on both ranges will be "bunched" together, making it nearly impossible to differentiate between frequencies. I used two separate boards so the meter could fit into any small box. This makes the meter more versatile, to suit your needs.



Schematic for the input amplifier and reference oscillator.

Parts List

Part	Description	RS#	Price
LM386	400 mW amplifier	276-1731	$1.09
555	timer/oscillator	276-1723	1.19
LED	any type	276-026	.35
R1	10kΩ potentiometer	271-1715	1.09
R2	100kΩ linear pot	271-092	1.09
R3	1kΩ ¼W resistor	271-023	.10
C1	0.1μF capacitor	272-135	.30
C2	0.0022μF capacitor	none	.50
S1	SPDT switch	275-613	2.59
	Case	270-230	1.69
	9V battery clip	270-325	.20
Total cost			$10.19

Calibration

To calibrate the meter, you'll need an oscillator with a known output frequency. Mark the internal oscillator pot (R1) with a series of divisions and set the pot to the first division. Tune the calibrating oscillator until the LED completely nulls, and mark the division on the pot with the frequency of the calibrating oscillator. Do this for all of the divisions in both ranges, and you're done.

If you can't get the LED to null, check the level of the signal going into the amp. Try placing the input potentiometer at a different level and then tuning the oscillator. You should be able to find a point where the LED will at least dim. With fine adjustment between the frequency setting and the input level, you should be able to turn off the LED.

Using the Meter

Simply rotate the internal oscillator pot until the LED extinguishes. The frequency marked on the scale of the pot is the frequency of the incoming signal.

This meter should prove to be one of your more useful pieces of test equipment. Its simplicity makes it almost problem free, and its versatility makes it useful for many other applications. Use your imagination, and I'm sure you will find numerous uses for it. 73

William Lazure KB5CTH, 1317 Commanchero Dr., Colorado Springs CO 80915.

73 Review *by Thomas A. Moulton W2VY and Robert A. Buaas K6KGS*

PacComm's NB-96 High Speed Modem

Dramatically increase packet data rates without buying a new packet system.

PacComm Packet Radio Systems
3652 West Cypress
Tampa FL 33607
Price Class: $100 (modem card)
Tel. (813) 874-2980

Looking for a way to get on higher speed packet but don't want to spend a bundle? These reviewers recently discovered a product that gave them many times faster packet operation without having to change rigs. In a number of cases, readers will also be able to use this modem without having to significantly modify their rigs or TNCs.

The PacComm NB-96 modem, licensed from James Miller G3RUH, the designer, is cost effective for high speed packet operations at 9600 bps. The NB-96 circuitry is mounted on a 3" by 5" card (see photo), and installs on any TNC-2 style modem disconnect header. It meets FCC bandwidth requirements for use on 50 MHz and above. Bandwidth is typically 16 kHz (26 dB) when operated at the recommended 3 kHz deviation.

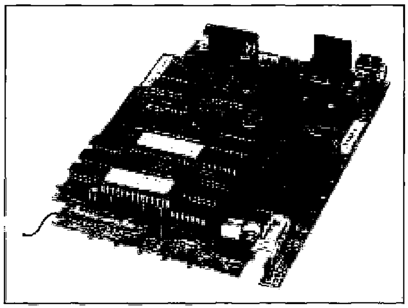
Selecting Your Radio

Your 9600 baud packet rig must meet four criteria: true frequency modulation, fast switching, fast receiver recovery, and a 20 kHz receiver IF. The NB-96 Modem takes advantage of the fact that you can transmit data at 9600 bps using a phase-linear channel capable of 4800 baud. In this particular case, the modem requires near-DC to 4800 Hz response.

FM vs. PM

What is the mode if it isn't "true FM?" Most so-called FM rigs, particularly many HTs, use a mode similar to FM, called phase modulation (PM). PM is widely used because it's easier to implement in most circuits than FM. The principal reason for this is that the design of an "FM-able" source oscillator is more complex. In PM you don't need to FM the source oscillator. The disadvantage of this mode, however, is that it changes the transmitted frequency based on the voltage of the modulator and the rate at which the voltage changes, which serves to distort the phase relationship. This is fine for voice communications, where low distortion doesn't seriously degrade the intelligibility of the signal, but high speed packet requires very high linearity.

Radios that modulate a varactor within the synthesizer PLL usually generate PM. If you have a radio that uses single conversion to get to the operating frequency, you can modulate the crystal in the mixer.



The PacComm NB-96 high speed modem card, mounted on a PacComm TNC-2 type TNC card.

Usually, crystal-controlled radios generate true FM. When they don't, you can easily modify them to generate FM by adding a varicap in series with the crystal.

Transmit Waveform Generation

The NB-96 contains a randomizer made from an m-sequence pseudo random number generator, the output of which is combined with the input data. The data stream has an even distribution of 1s and 0s. This has some good effects: the signal is always an AC signal; you can more reliably extract NRZI clocking information; and the energy is more evenly spread throughout the occupied bandwidth of the signal. Since the input data stream is NRZI HDLC, zero bit insertion and clocking information assure a steady supply of transitions which will help avoid randomizer lockup.

Electronic Switching

Due to the high data rate, your radios should be able to switch quickly from transmit to receive, and vice versa. For example, 100 ms (0.1 second) is enough time to send a 100-byte data packet between two directly connected stations. The same packet sent at 1200 bps would take 800 ms.

Use PIN diodes for antenna switching because mechanical relays are slow.

Most synthesized radios use a single PLL for both transmit and receive. The PLL usually has to lock on frequencies that are as much as 10 MHz apart. It can take a lot of time to reprogram and lock the PLL. Some crystal-controlled radios completely turn off the entire receiver, including all oscillators, which can cause delays as long as 1 second. Small, handheld radios (HTs) may fail one or more of the above criteria; we haven't tried interfacing to any.

Evaluate the receiver IF filter(s) carefully. James Miller makes a big point about the required bandwidth of the filters, the need for very good phase linearity, and group delay. If the receiver you are using has two filters, the first filter (10.7 or 21.4 MHz) should have 20 kHz (D suffix) bandwidth, and the second filter (usually 455 kHz) should be wider, enough so that its skirts do not appear in the overall bandpass. 30 kHz (B or C suffix) is usually wide enough, because these ceramic jewels are seldom centered exactly on 455 kHz.

A simple test with a communications test set tells you if the receiver will perform well. Set the synthesized signal generator in the test set to channel center and adjust the RF signal amplitude for 20 dB noise quieting. Look at the receiver output (at the demodulator, with no de-emphasis, or at the output of the modem bandpass filter) with a scope, while modulating the signal generator with frequencies from 20 Hz to 4800 Hz. The amplitude and shape of the wave should stay the same regardless of the modulating frequency. Set the signal generator above and below the center frequency by 1.0 kHz and check for serious wave shape distortion. Decrease the deviation if necessary to improve the shape. Note the amount of deviation used to accomplish this (it will probably be smaller that you might imagine).

The rule-of-thumb bandwidth equation:

$$B = 2f + 2d \text{ where:}$$

B is the bandwidth, f is the highest frequency in the modulation, and d is the deviation from channel center outward. For $B = 16$ and $f = 4.8$, $d = 3.2$ (all values in kHz). This leaves room for $\pm$ 2 kHz system drift over time.

TNC Selection

Most prominent TNCs have modem disconnect headers available for connection to external modems like the NB-96. This header is usually a printed circuit pad pattern which accommodates a dual-inline connector. Before installing the connector, be sure to cut the traces which connect the SIO to the internal 1200 baud modem. For testing, we suggest

making a jumper plug to reconnect them when needed.

Follow the instruction provided with the NB-96 and with your TNC. The NB-96 instructions covered the interfacing of the modem to the TNC and gave general guidelines for interfacing the modem/TNC combo to rigs. As the product is still quite new, there's still not much information about interfacing it to specific ham rigs, and the manual asks users to send PacComm such information as it comes up. They may include it in future versions of the docs. For now, however, be prepared to know something about interfacing these units to ham rigs on the rig end. They do, however, have quite a bit of info on interfacing to specific commercial telemetry rigs (see below).

Be sure to verify that the TNC provides a TAPR TNC-2 style modem disconnect header. We interfaced to the TAPR TNC-2, the MFJ-1270, and the PacComm Tiny-2 with equal success.

Up the Data Rate Further Still!

Yes, it's possible to double the data rate to 19.2 Kbps. Just halve the values of the frequency-determining capacitors in the NB-96 receive and transmit active filters, and double the clock frequency. Similarly, to halve the data rate (4800 bps), double the capacitor values and halve the clock. The NB-96 documentation lists the capacitors you need to change. As the bandwidth required is only 35 kHz, you can operate 19.2 Kbps on the 1.25m and shorter wavelength bands.

Of course, going to 19.2 Kbps requires higher IF widths in your rig. You need 30 kHz for the first IF filter in the receiver. Change the second IF filter to provide 40 or 50 kHz at the 6 dB point. Ceramic filters usually won't make this bandwidth, even by careful selection. One solution is to use several LC cans, loosely coupled and stagger tuned, to provide a uniform response. Making this work is eased considerably if you have a 10.7 MHz sweep generator, the kind broadcast FM radio technicians use.

Transmitters

The transmitters K6KGS has used either already had a varicap in series with the crystal, or one added. The NB-96's modulating voltage couples directly to the varicap. He has used both the Hamtronics and Spectrum Communications 220 and 420 MHz transmitters as well as commercial Motorola Micor exciters, using the special Channel Element which provides Automatic Frequency Control (KXN-1019) without modification.

K6KGS has also used Midland 13-509 220 MHz transmitters, which are popular hamfest items. All he did was remove the phase modulator and add the varicap modulator. With a few modifications to the Midland radios, the RX/TX switching and the TX/RX switching was brought down to 3 ms each, which is acceptable. You can get the specifics on interfacing these rigs from Bob Buaas K6KGS at PacComm.

All of K6KGS's synthesized rigs switched the VCO between frequencies for receive and transmit. This transition took about 120 ms in each direction. This equates to a "DWait 12" and "TXDelay 12" (i.e., 120 ms each). This time delay at 9600 baud is equivalent to a 128-byte data packet. You can see that these time delays are unacceptable. Units with separate internal VCOs for receiver and transmitter might be acceptable if the direct modulation characteristics are phase linear, but I do not know of any such units on the ham market. Many comtemporary rigs, which are by and large PLL rigs, have time delays of at least 100 ms.

K6KGS has had five stations running 9600 and 19,200 baud continuously for more than six months, using a combination of modems, radios, and frequency bands, with no problems. The longest path is 80 miles, between mountaintops.

Telemetry Radios

Thomas W2VY integrated the modem with different radios, mostly telemetry radios, with very few problems. Some of the most commonly used of these rigs are Maxon VHF HTs and 30W mobile UHF rigs, and Johnson VHF rigs. Little, if any, alignment is necessary. When it is necessary, all you need is an audio oscilloscope with external trigger. W2VY found that the best way to tune the receiver to the correct frequency was to use the scope as a tuning eye, then adjust the received data for the cleanest waveform.

Telemetry radios operate from 1W to 5W. On the surface this may sound like weak-signal work, but FSK gets about 6 dB gain in the signal-to-noise ratio over AFSK. Running 5W FSK is like 20W AFSK.

Major radio dealers, such as Motorola, Johnson, Maxon, and Standard, have telemetry radios in the $300 price class. Contact PacComm for more information.

One-Evening Project

If you've selected the right radio, it takes only an evening to interface it to the NB-96. Compared to 1200 baud, the systems exhibit substantial throughput improvement. The systems were relatively easy to construct, using only the most unsophisticated test equipment. Currently in amateur packet radio, 9600 baud is a common backbone rate, while user rates are still at 1200 baud. As the backbone data rates increase, however, to 56Kb and beyond, 9600 baud will be a natural step for user access channels.

The modem also has an EPROM and jumpers to "optimize" the characteristics of the transmitter and receiver of a specific link, as a way to make the modem more accommodating to different rigs. We found this feature unnecessary, however, and evidently PacComm received enough similar feedback to lead them to remove jumpers JP1–JP4 and the EPROM on the surface mount version.

Suggested Improvements

James Miller suggests that you run the modem transmit output stage at 1V peak to peak minimum, and use voltage dividers to feed the rig's modulator. In some cases you'll have to add an external resistive pad to bring

your drive voltage down low enough for the transmitter. PacComm may want to consider building this onto the board in future versions of the NB-96.

Multi-Speed Channels

DON'T try to use modems of differing data rates on the same channel—unless you have very good control of ALL the stations on the channel, such as a network trunk.

Why? This is because packet stations currently use Carrier Sense Multiple Access (CSMA) which assumes that every station can hear every other station. A station that your station can't hear is called a hidden transmitter. This means you will transmit. A TNC may not "hear" a transmission of a foreign data rate because it decides that that signal is not a signal, and so transmits. Nonetheless, the wave energies appearing simultaneously on the channel mutually corrupt packets, causing retries, dragging down throughput.

When two stations are running different modem speeds, they will generally appear as hidden transmitters to each other. If all the packet controllers on a channel are connected to the radio using the RFDCD line, multi-speed operation can work. The RFDCD signal from the radio should be active when an RF carrier is present. In practice, this doesn't work with 9600 bps carriers because most radios are looking for a voice carrier. The noise detector will see the high frequency components of the data and decide it is only noise for all or part of the packet. Most stations are not wired this way, and it only takes one station on the channel that's not wired this way to destroy throughput.

Because of the variety of equipment used, multi-speed channels aren't practical. To provide 9600 bps user access, an existing channel must be cleared, or a new channel opened up for high speed operations. Currently, the most attractive idea for accommodating these channels is to alternate them between 1200 baud packet channels from 144.9–145.1 MHz. Before doing anything, however, be sure to clear it with your local repeater coordinator. Network trunks are usually set up with local/regional coordination between packet network providers, so conversion to higher speeds is much easier.

Most amateur packet stations are not equipped to support multi-speed operation, and the problems of detecting all carriers vs. speed segregation need to be examined more closely.

Other modems, such as the K9NG Modem and the modem on the new UoSAT-D scheduled for November launch, should be compatible with the NB-96. This will allow you to operate packet with this new bird.

Conclusion

We have found this modem to be relatively easy to implement, and has not given us any troubles for the combined year that we have been using it. For anyone who is not afraid to perform to perform a few minor modifications to their equipment, we wholeheartedly recommend this product. ■

Sing for the Unsung Heroes

Give credit to your club's workhorses!

by Jack Parker K5CVD

November and December are two of my favorite months. November is the advent of the holiday season, and December gives us a chance to do something good for someone else. I don't mean just giving Christmas presents, either.

During November and December, most amateur clubs around the country hold an end-of-the-year celebration. It doesn't matter whether it's called the annual awards banquet, a Christmas party, or a New Year's celebration. What matters is that this is the occasion when the outstanding members of the previous year are honored. It is an exciting time for many of us.

I suggest here a way to make it even more exciting and meaningful.

In every organization there are people who give quiet, ongoing service to their fellow members, without expectation of recognition. The services these humble folk render are usually necessary drudge tasks that others do not wish to do, but that must be done by somebody.

"Drudge tasks?" you ask. "What tasks in our hobby would anyone associate with drudgery?" Well, friend, there are numerous jobs that get done every day that involves a lot of slogging—very late and very early hours, hours of routine, etc.—for the person doing them, but which bring joy and satisfaction to others. Let's consider a few.

Our Very Own Public Utility

It's three o'clock in the morning. You slowly turn the tuning knob on the TS-140 hoping for that weak station you haven't worked yet, when suddenly the lights go out, the rig dies, and a painful silence fills the night where the merry hum of a distant generator sang just seconds before. After sitting for a moment, startled, you begin rummaging around the tent for a flashlight you hope is there somewhere, and finally roar in anger and frustration, "Curse you, Murphy!!!"

Then, as you are about to brave the darkness to try to correct the generator problem, the night is again filled with that reassuring hum, and the lights and rig are aglow once more. Moments later a friendly face pops through the door of the tent. "Sorry, ran out of gas—but you're all set now." Grumbling at the lost time, you return to the earphones and continue the search for the next field day contact, while your very own personal utility hums on in the night under the watchful eye of—Say! Who was that masked man?

While The Rest Sleep

Saturday morning, 6 AM. The alarm clock screeches its soul-rending announcement that rousts the volunteer out of bed on this weekend day. He showers and dresses quietly (doesn't want to wake the family), then begins loading the car with banners, boxes, and a large coffee urn.

6:45 AM. He pulls out and heads for the center, stopping at the all-night donut shop *en route*. A box of three dozen assorted donuts goes onto the pile in the front seat as he rolls on to his destination. After arriving at the test site, he unlocks the building, pops on the lights, gets the coffee going, lays out the donuts, and attends to the myriad of other mini-tasks that takes up three quarters of an hour in an instant...

> ***"Say! Who was that masked man?"***

7:30 AM. The first of the VEs arrive, grateful for the coffee and donuts, and thoroughly preoccupied with the coming exams. The volunteer helps unload the material, and then returns to his corner of the kitchen to keep the coffee and donuts flowing.

"Tom, would you take the examiners another round of coffee?

"Sure, no problem!"

That Tom—what a super guy. Tom who?

Just the Newsletter

"Hi, honey, thought I'd call and see what we got in the mail."

"Not much," she replies, "just some magazines and the club newsletter, same old stuff we always get about this time of month."

The same old stuff...Well, friend, that club newsletter made it to your mailbox with the help of a volunteer who takes time out of his busy schedule once a month, licks many dozens of stamps, sticks them plus address labels to many dozens of newsletters, sorts the newsletters by zip code, and drives to the post office to mail them. Whoever does this *has* to be a volunteer—club dues often don't even cover the cost of the materials to produce the newsletter, much less printing them and preparing them for mailing! To this, many say: "Hey!! I pay my dues to the club, they owe me a newsletter," when it would be better to say: "Gee—I don't know who pitched in their time, but know I owe them some thanks!"

Hundreds More Like Them

These people are just a few of the many quiet selfless workers you find around every club who make it possible for the rest of the membership to enjoy themselves. These folk work hard to see that the wheels of club activity turn smoothly. Don't you think it's time to give them a pat on the back?

Show'em You Care!

Take a chance on looking foolish. Go to the next club board meeting, and tell the "movers and shakers" of your organization that it's time to pay tribute to the "greasers and easers" of the club, and let them know they're appreciated.

It's so easy to do! Practically every computer today has a graphics package for creating custom-designed certificates, and every club has at least one "guru" of graphic arts. Most stationery stores sell generic certificates of appreciation. Nicest of all, though, is the hand-lettered certificate.

Make up a list of recipients for this "appreciation award," make certificates one way or another, and have the president of the club sign them.

This year, as a proud member of one of the largest free public service groups in the world, let's let our fellow hams know that "who cares" refers to us! This year, as we enter the holiday season, let's sing for the unsung heroes. 73

Jack Parker K5CVD has been a ham since 1957. Other interests include fishing, camping, and community theater. You may reach him at PO Box 356, New Ellenton, South Carolina 29809-0356.

Easy Tuning for the Uniden HR2510

For easier and safer 10 meter mobileering.

by Carl A. Kollar K3JML

If you were driving down the road and noticed the driver in the car in front of you leaning forward, to the right and down, and staying that way, wouldn't you naturally assume he got his fingers stuck in the heater vent? Many people who enjoy mobile hamming, however, also spend a lot of time in this position, if they are using the nifty little Uniden HR2510 10m mobile rig. On this rig, to tune meticulously from one end of the active SSB portion to the other takes a lot of knob twisting. At the same time, of course, they have to pay attention to their driving. There had to be a better way!

Photo A. Completed circuit built on a portion of perfboard. There are only 10 components to install!

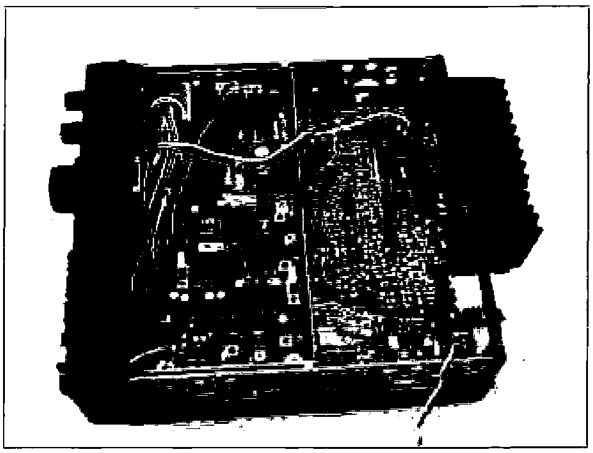


Photo B. Circuit board installed in the HR2510. There's plenty of room for easy mounting.

The Annoyances

The 2510 really is a nice little mobile rig, but some minor annoyances quickly become evident. (1) The up-down button on the mike QSYs in 10 kHz steps only. In my opinion, this makes it useless for fine-tuning the band for SSB stations. I can't think of any time this feature would be useful. (2) It has no offset for 10 meter operation. (3) The receiver RIT control has no disable; you can call stations until you're blue in the face, and not get an answer because you're on different receive and transmit frequencies.

I understand the new HR2600 corrects all these "problems," and that's great, but what if you don't want to go through the hassle of selling your rig and spending more money to get the newer model? The April 1989 issue of *73* features an article by WB9WDH and WA9QDZ called "FM Split for the Uniden HR2510," which pretty well takes care of the repeater offset problem. And, although I haven't seen it yet, I understand there's also a mod that takes care of the receiver RIT problem.

Tuning from the Mike

I needed a nice little mod that would give me useful up-down buttons on my microphone. When you're normally tuning with the front panel knob, you can select 0.1 kHz, 1 kHz, or 10 kHz tuning increments with the span button. The 100 Hz position is the most useful in tuning SSB signals. I needed to make the radio "think" it was receiving its directions from the front panel frequency control, when in actuality it was receiving from the mike buttons.

The first step was to investigate what kind of "signal" the up-down buttons on the mike supplied to the radio. A little investigation found that an "up" depression put a ground on the black mike wire, while a "down" depression put a ground on the white mike wire.

The next question was: What kind of indication from the frequency knob on the front panel did the transceiver need to change frequency up or down? Some physical lead following lead to jack J307 on the main circuit board. (See Figure 1.) A little scope probing soon revealed that for an "up" command, a positive going pulse was needed on J307-3, and for a "down" command, a positive pulse was needed on both J307-2 and J307-3.

Furthermore, these points could be pulled high by an external source to effect the frequency change. They weren't a solid low when not activated, just at ground potential (probably held there by pull-down resistors). I was able to make the frequency change by manually jumping +5V with a wire to these points, just as if I were using the front panel knob. Also, since the radio "thought" that it was receiving its instructions from the frequency knob, the span switch was still effective in determining the tuning increments.

So, there I had it--all the elements I needed to design my circuit. I needed an interface which would intercept the up-down mike switch depressions, create a pulse train for easy tuning, and route those pulses to the appropriate points to continuously tune the

radio from the mike, just by holding the button down. The result of that design is shown in Figure 2.

Circuit Workings

The 4001 is a CMOS quad 2 input NOR gate. On any one gate, with either or both input high, the output is low; with both inputs low, the output is high. Sections A and B are configured as an astable multivibrator to generate the clock pulses needed to eliminate the need to depress the mike button for each tuning increment.

The rate at which the tuning takes place (clock frequency) is determined by the 0.1 µF capacitor and the 470k resistor. The 4.7 megohm input resistor is generally 10 times the value of the timing resistor, and contributes to 50% duty cycle as well as independence of the clock frequency from supply voltage variations. With the values shown, you get about 2 pulses per second, apparently a comfortable tuning rate. You can fine tune SSB signals without overshooting the target frequency or tuning too slowly.

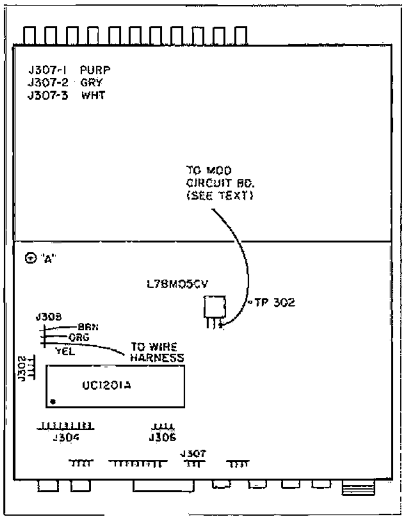


Figure 1. The opened HR2510. Front panel faces down.

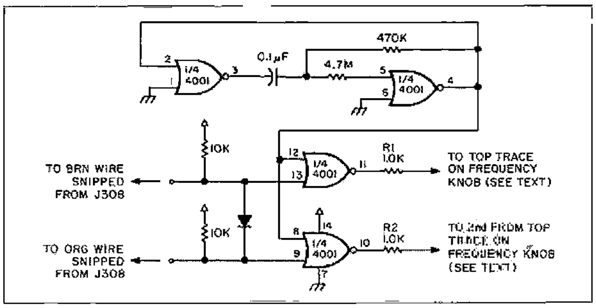


Figure 2. Schematic for the mike tuner interface, which fits into the HR2510.

The output of the multivibrator (pin 4) is fed to pins 12 and 8 of the other 4001 sections, which are used as gated inverters. (The gating is what we're after; the inverting has no serious consequences for our application). At this point, the pulse train goes nowhere until one of the other gate leads is grounded (ultimately by either the up or down mike button). If the "up" mike button is pressed, pin 13 of section C is grounded, and a pulse train is output from pin 11 through the 1k isolation resistor to the white wire on J307, causing the HR2510 to increment one digit per pulse.

If the "down" button is pressed, a ground is placed on pin 9 or section D of the 4001. Also, the diode between pins 13 and 9 become forward-biased and applies a near-ground on pin 13 of section C. This causes a pulse train at both pins 10 and 11, through the isolation resistors and on to the white and gray wires on J307. This, in turn, causes the HR2510 to decrement one digit per pulse for as long as the button is held down. The circuit is simple, but it serves very well as the interface to accomplish our purpose.

Building the Circuit

My prototype was built on a portion of perf board with a pad-per-hole configuration purchased from Radio Shack. The component count (10) is so low, I didn't take time to try to design and etch a printed circuit board. It took me half an hour to build the circuit (see Photo A). Fabricating a PCB would have taken longer than that.

Using the layout shown in Figure 3, mount the components. In most cases, you can make connections using the extra length of the component leads. For those of you who are using the Radio Shack circuit board, the Component Mounting Guide table may help. After placing the parts (as shown in solid lines), and the wires underneath (in broken lines), make the proper connections.

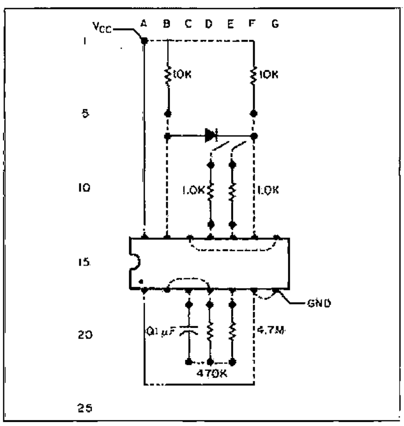


Figure 3. Parts placement for the mike tuner interface.

Refer to the perfboard in Photo A. The 1k resistors between D8 and D12 have leads going into D8, then pulled up through D7 to connect to the HR2510. The same goes for the 1k resistor between E8 and E12. Pull the lead down through E7 and then back up through E8. When the circuit is built, cut off the excess board along row 25 and column J.

Cut six 12-inch lengths of wire. Attach a red wire to A1 on the circuit board (wire from IC pin 14) and a black wire to A3 on the circuit board (wire to pin 1 on the IC). These are your positive and negative supply leads respectively. Connect another wire to the resistor end looped through D8 and D7, and another to the resistor end looped through E8 and E7.

Finally, carefully solder a wire to the anode of the diode (location B6, or even better, the resistor lead at B5) and another to the cathode (location F6, or even better, to the resistor lead at F5). Temporarily, set the board aside.

Installation

With the front panel facing you, and the bottom cover facing up, (the side with the speaker), remove the four side screws holding the cover. Carefully remove the bottom cover, paying particular attention to the wires still attached to the speaker mounted on the cover.

I found it convenient to unsolder the speaker wires and set the bottom cover aside. You can see that there is plenty of room in the rear half of the radio for extra goodies. Press two layers of double stick tape to the bottom of your board, then press it firmly onto the HR2510 circuit board in the left rear corner (see Photo B).

Attach the six wires coming from the circuit board as follows:

1. The ground wire of your circuit board (IC pin 1,6,7, etc.) is routed along the left edge of the chassis and fastened under the screw at point A. (Figure 1)
2. The voltage supply wire (IC pin 14, etc.) is routed toward the center and to the L78MO5CV regulator. Carefully solder to the right hand lead as shown in Figure 1.
3. The lead coming from location D7 (the resistor R1 connected to pin 11 of the IC) is carefully routed down the center and toward the frequency knob. Carefully solder to the top trace on the frequency control circuit board. This is the trace with the white wire attached to it.
4. The lead coming from location E7 (the resistor R2 connected to pin 10 of the IC) is carefully routed down the center and toward the frequency knob and soldered to the next trace down on the frequency control circuit board. This trace has a gray wire attached to it.
5. Refer to Figure 1 and locate J308 with the brown, orange and yellow wires attached. About 1 inch from the connector, cut the brown and orange wires. This will allow easy restoration of the HR2510 to its original configuration.
6. Connect the wire coming from the anode of the diode on your circuit board (location B6 or B5) to the longer brown lead going into the harness snipped from J308. Connect the wire coming from the cathode of the diode (location F6 or F5) to the longer orange lead going into the harness snipped from J308.
7. Installation is now complete. Inspect all wiring before applying power.

Testing

Testing is very simple. Turn on the power. All controls should work normally. Manually turning the frequency control should increase or decrease frequency by the increments selected by the span button.

Now for the good part! Depress and hold the "up" button on the mike. The frequency should slide effortlessly up the band at about 2 increments per second. Try the "down" button. It should slide down the band at the same rate. Isn't this much better than manual tuning?

If you think that this is good, wait until you try it while you're driving!

Conclusion

This project is easy. With the proper care, it should go very smoothly. From start to finish, it should take about 2 hours. It's worth the effort and sure beats selling the whole rig to buy the upgraded version.

If you're a little squeamish about messing around inside your rig, you can send it to me *insured* with a check for $50.00 to cover parts, labor, and return shipping. I'll be happy to modify it and return it within a week of when I get it. Just remember, if it's in warranty, this mod will void your warranty.

Enjoy the easy tuning, and see you on 10m! 73

Carl A. Kollar K3JML, 1202 Gemini St., Nanticoke PA 18634.

Parts List

Qty	Description	Radio Shack Part #	Price
2	10kΩ ¼ W resistor	271-1335	.39, pkg. of 5
1	1N914 diode	276-1122	.99, pkg. of 10
2	1kΩ ¼ W resistor	271-1321	.39, pkg. of 5
1	14 pin IC socket	276-1999	.89
1	0.1µF 50 V capacitor	272-135	.59, pkg. of 2
1	470k ¼ W resistor	271-1354	.39, pkg. of 5
1	4.7M ¼ W resistor	Local TV repair shop	
1	4001 CMOS IC	276-2401	.99
1	project board	276-158A	2.29
1	high bond double stick tape	64-2361	1.99, pkg. of 2

Component Mounting Guide on Radio Shack PCB

Component	Mounting Points
10k resistor	B1 to B5
10k resistor	F1 to F5
1N914 diode	B6 to F6
1k resistor	*D8 and D7 to D12
1k resistor	*E8 and E7 to E12
IC socket, pins 14 to 8	A13 to G13
IC socket pins 1 to 7	A16 to G16
Jumper wire	A17 to A23
Jumper wire	B23 to F23
Jumper wire	A1 to A12
0.1 µF capacitor	C17 to C21
470k resistor	D17 to D21
4.7M resistor	E17 to E21

*See text

Three-In-One Antenna Tuner

Matches virtually any random wire!

by J. Frank Brumbaugh KB4ZGC

Operating your rig on Field Day, or under severe conditions following a natural disaster, often requires using less than optimum antennas. Tuning these antennas of unknown characteristics may be more than your present antenna tuner can handle, and result in too high a standing wave ratio (SWR), a condition solid state rigs abhor.

Because Field Day and emergency operation is usually low power, you can put together this tuner from parts in most junk boxes. Assuming a maximum of approximately 50 watts output, the capacitors can be anything from 100 pF to 365 pF broadcast receiver types. The inductance is a tapped coil, and may be a piece of miniductor, a toroid such as a T106-2, or a surplus rotary inductor. For such low power, standard or miniature wafer switches work fine.

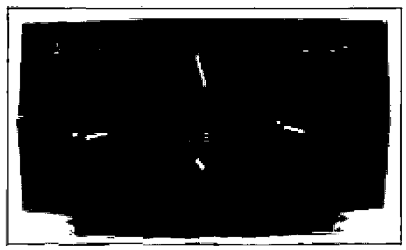


Photo A. Front panel of the three-in-one tuner.

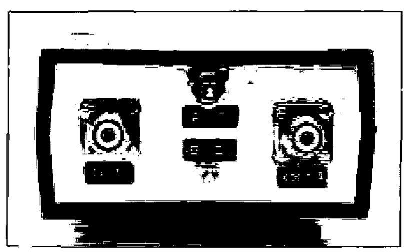


Photo B. Back panel and bottom inside view of the three-in-one tuner. Wire lengths are not critical, since the tuner handles only HF frequencies.

Antenna Tuner Circuits

To make this tuner as versatile as possible, yet simple to construct from junk box parts, I included three standard antenna tuning circuits capable of handling just about any odd piece of wire you may have to use, as well as more standard antennas. A 4P3-position wafer switch chooses each of the three tuner circuits available. These are designated A, B, and C, as illustrated in Figure 1.

Circuit A will tune random wires with a relatively high impedance at the input. Circuit B tunes random wires with a low impedance input, such as a quarter-wavelength at the operating frequency. Circuit C is the standard T-configuration used in many commercial antenna tuners. It will feed coax feeders, twinlead, or single wires of a wide range of impedances.

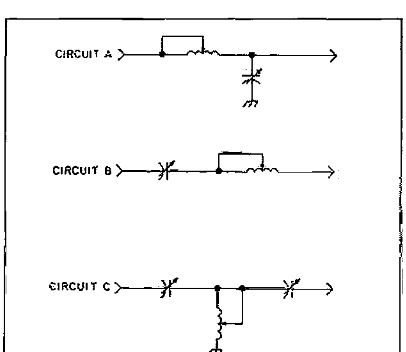


Figure 1.

Figure 2 shows the tuner circuit. Switch S_1 is a 4P3-position miniature wafer switch which chooses the tuner circuit required by the antenna. C_1 is active only in circuits B and C. C_2 is active only in circuits A and C. The tapped coil is active in all three circuits.

Operation

Working the tuner couldn't be simpler. One of the three available circuits will tune just about anything in the nature of an antenna you happen to want to use. Simply set the capacitor(s) at midrange, choose the tuner circuit you think will give the best results, apply power, and adjust the coil tap switch S_2 and capacitor(s) for minimum SWR. If you cannot reduce SWR to less than 2:1, try a different circuit with S_1 and retune as described above. Just take care to never switch it with RF applied to the tuner, except for the coil tap switch.

Parts

Although most hams will probably have all the parts necessary in their junk boxes, for those who may need something, I suggest swapping with another ham, or visiting flea markets or hamfests.

Tuning capacitors are available from: Small Parts Center, 6818 Meese Drive, Lansing MI 48911; Fair Radio Sales, PO Box 1105, Lima OH 45802; and BCD Electro, PO Box 830119, Richardson TX 75083. Other mailorder dealers carry them at reasonable prices. T106-2 toroids are available from Small Parts Center, and from Amidon Associates, 12033 Otsego St., North Hollywood CA 91607. Wafer switches are available from these sources and many others.

You can construct this tuner in just a few hours. You don't have to build it in a box, but you can. Cabinets which accomodate this tuner are readily available from Radio Shack and a few surplus dealers, such as Fair Radio Sales. Because the capacitor rotors must be insulated from ground, you may wish to construct it on a wood or Masonite panel. If you do much experimenting with antennas, you will find this tuner extremely handy. And it will be priceless on your next Field Day outing as well as serving under adverse conditions in emergencies. 73

J. Frank Brumbaugh KB4ZGC, 82 Liddell Street, Buffalo NY 14212-1824.

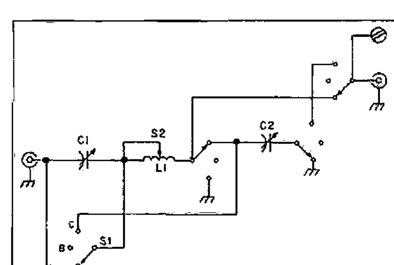


Figure 2. Three-in-One antenna tuner schematic. This circuit combines the three circuits of Figure 1.

Number 14 on your Feedback card

73 Review *by Larry R. Antonuk WB9RRT*

Elenco AC Adapter

Put your elec-tech knowledge to better use around the house.

Elenco Electronics, Inc.
150 W. Carpenter Ave.
Wheeling IL 60090
Phone: (312) 541-3800
Price Class: $32

The FCC doesn't issue it, but somewhere between Tech and General most hams get a "Mr. Fixit" license. Like the old commercial ticket, this license has various endorsements—ranging from "Flashlights and Floorlamps" all the way up to the coveted "Anything That Plugs Into The Wall."

Luckily, most of us have the basics. A meter's a meter, and the 'scope that fixes your packet rig works just as well on an AM/FM car radio. But what about some of the more mechanical stuff? Can I fix a washing machine with an oscilloscope?

No, not really. You don't need to. As it turns out, most of the professionals who do home appliance repair use just a few instruments: A DVM, a test fixture or two for specialized cases, and an AC current probe.

The Essential Tool—Affordable

A what? A current probe. A current probe is simply a device that measures AC current. Most of us are familiar with current measurements—you open one side of the circuit, insert your meter, and power up. Unfortunately, spreading wires on the floor in series with your meter isn't always practical when dealing with 120 or 240 VAC. In addition, most meters have a maximum input of ten amps, making them unsuitable for most major appliances. The current probe was developed with the idea of reading current in the range of one hundred amps or so, with the benefit of not needing to break one leg of the circuit.

Until recently, clamp-on current probes have always been expensive. Several months ago, however, I came across the newly released ST-265 AC Clamp-On Current Adapter from Elenco. This device, which performs precision current measurements from 0 to 1000 amperes at 60 Hz, retails for under $35. The low price reflects the fact that the unit is an adapter, not a complete unit in itself. Just plug the ST-265 into any high impedance DVM, switch to a millivolt scale, and read the current directly from the display (one millivolt equals one amp). The Current Adapter has a basic accuracy of 2.5% of the reading, ± 4 digits. (If precise accuracy is necessary, note that the accuracy of your DVM needs to be figured in as well.)

Using the Current Probe

Putting the ST-265 to work couldn't be simpler. You don't need to physically connect it to a conductor to measure the current passing through it. It senses the current flow by induction. This means you don't have to go through the hassle of trying to place the probe on a connection point (often recessed to keep it away from straying fingers), or stripping off conductor insulation and taping it over after measuring.

For instance, in the case of a stalled washing machine motor, you clamp the Adapter around one of the power leads and read the current. Mechanically disconnecting the motor from the transmission and taking another reading will indicate either a defective transmission or a defect in the motor, such as a shorted winding or dry bearings. Once things are corrected, you can easily check the start and run currents. Consider an intermittent circuit breaker in the house wiring. Is the breaker bad, or is the load approaching the rating of the breaker? The ST-265 can tell you in a second. How much does it cost to run that kilowatt amplifier? Just measure the current, convert to power, find out the local electrical rates, and, well, uh, . . . never mind.

Addictive

Perhaps the only drawback to the ST-265 Current Adapter is that it can be too much fun to use. The tech is often seen running around the house with his Current Adapter and calculator, saying things like: "Hey! Turn that off! Don't you know that hair dryer costs 10.277 cents per hour to run?? Go watch TV! That's only 2.345 cents!!" After a couple of nights of this, the family firmly escorts the would-be technician downstairs to his shop.

"And while you're down there, take a look at that broken washing machine!" 73

Larry Antonuk WB9RRT has written numerous reviews on test equipment and electronics books for 73 Magazine. He currently works as a project manager for a land mobile service shop in Keene, New Hampshire. He enjoys home-brew projects, experimentation, and instrumentation. Contact him at PO Box 452, Marlborough NH 03455.

Continued from p. 22

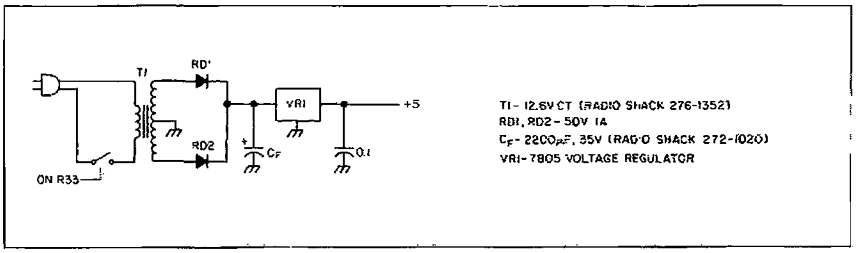


Figure 5. Schematic for power supply for BitChaser.

lengthen it to 40 bits (add another 74164 shift register), or use 4-bar graph chips, but leave the last eight bits unused.

Whichever method you choose, align the diodes as carefully as possible when you solder them in place, otherwise the display will ripple as the lighted areas move across the display.

Layout Design

With some clever board layout, you can minimize the number of interconnects and wires between the shift registers, the LEDs, and their current-limiting resistors. For example, you can put the resistors on either the power supply side or the IC side of the LEDs, and use the resistors themselves as the interconnecting wires, saving 32 pieces of wire and 64 solder connections!

Exact parts placement and board layout depends on what kind of a case you use. I used a junked Heathkit FET VOM case, with the board mounted vertically behind the front panel, and the LEDs in a window where the meter used to be, leaving room for the various switches and other controls on the right side. The crystal and variable clocks are mounted on a small board attached to one end of the case. (The PC board shown in the parts list has plenty of room for the entire circuit of the BC, without using sub-boards: the photos show what I had in the junk box at the time.)

The power transformer, rectifier, and regulator are mounted on the back of the case. Point-to-point wiring was used throughout, and no PC foil patterns are available at this time. A toggle switch near the bottom center of the front panel, originally meant to be the power switch, is unused, as the pot selected for the Scan Delay control happened to have a switch. Two strips of red plastic cover the LED display string and the two 7-segment displays just above the LEDs. I used small pieces of PC board to mask off the rest of the original meter hole in the VOM case.

Exactly what panel arrangement you use depends on the case and circuit board you pick. The same is true for exact parts placement on the circuit board; the parts placement is not critical and should have no effect on operation. Just use normal TTL construction practices, like liberally bypassing supply lines with .1µF capacitors.

Instead of using the relatively large PC board in the parts list, you might consider three smaller boards, one for the clock and divider circuits, one for the control logic and counters, and one for the shift registers and LEDs. This may make construction and panel layout easier. Again, there is nothing critical in the circuitry layout—just put things where they are convenient, and group the controls and jacks in a logical way for ease of use.

Using the BitChaser

The prime operating mode, for which the unit was originally designed, is the Sync Start/Clocked Stop mode, used for capturing and displaying pulses that are (or are not!) supposed to be on a particular line. This is especially useful for trapping glitches, which are generally shorter than valid data.

With an External Start signal, you can easily measure the time before another event occurs, such as an acknowledgment from a circuit controlled by a computer output signal. With both an External Start and Stop, you can see what happened on a third line in the time between two those signals. Note that the External Start or Stop requires *negative-going* (high-to-low) transitions to work properly.

You can use the internal calibrated and variable clocks as general-purpose TTL squarewave sources. The BC works as a frequency counter up to about 2 MHz, if you are interested only in regular, repeating signals, and you're willing to do the simple division to convert "period" to "frequency." Again, however, the unit as shown will only work on TTL signals; to count sinewaves or signals at other voltage levels, you will need some sort of external translation/squaring circuits.

As a signal generator, the ability to program in any conceivable bit pattern, then play it out once, or continuously, and at any of several calibrated or adjustable bit rates, provides a very flexible test generator. Finally, if you insist on using that oscilloscope, you can capture some data, go into the recycle mode, attach the scope to the signal-out jack, adjust the scope sweep, and you've got a storage scope!

For The Future...

Another feature I considered, and may back-fit some day, is a shift register hidden in the recirculate loop. It would be a relatively long register (64 bits), but have no LEDs. It would allow for much longer data capture periods, then you would use the recirculate mode to cycle it through the registers that do have the LEDs.

If you add a shift register, you will need eight 74164s (or 74LS164s, to avoid overloading the clock signal), and some sort of decoder to detect a count of 96 in the clock counters, to stop the clock. Note that with 96 bits total, you can actually program in your callsign in ASCII, Baudot, or Morse, and use the BC as a triggered or repeating callsign generator. If you include this option, I strongly suggest that you retain the 7-segment displays, so you can tell where you are in the hidden/displayed bit pattern.

Happy bit-chasing! 73

Ron Cole K4OND was first licensed in 1960. He has a B.Sc. in Physics and an M.S. in Information Systems Management. Besides ham radio, his interests include computers and horses. He is now stationed in Washington, D.C., as a Captain in the US Navy. You may reach him at Apt. 709, 1111 Arlington Blvd., Arlington VA 22209.

Parts List

Part	Description	Cost Total Quantity
IC1, IC13	7400 Quad NAND	$ .38
IC2–IC5	74164 8-bit SIPO shift registers	3.40
IC6	7474 RS flip-flop	.32
IC7	7410 Triple 3-in NAND	.18
IC8, IC9	74192 BCD counters	1.50
IC10, IC11	7447 BCD to 7-Seg, JDR Microdevices	1.88
IC12	555 timer	.90
IC14	7473 JK Flip-flop	.35
IC15–IC18	7490 BCD counters	1.56
IC18	556 Dual timer	1.25
D1–D32	Subminiature discrete LED	4.00
S1–S3	SPDT Toggle, RS 276-603	4.68
S4	1P12T rotary switch, RS 275-613	1.39
S5–S7	N.O. push switch, RS 275-1547	2.69
S8	1P3T rotary switch, RS 275-1386	1.39
R33	1 megohm pot, with switch, RS 271-211	1.78
R34	10kΩ pot, linear taper, RS 271-1715	1.09
C1, C4	10 µF electrolytic, SSS	.80
C2	0.47 µF, SSS (5/$1)	1.00
C3	0.01 µF, RS 272-131	.49
Y1	4.000 MHz crystal, JDR Microdevices	1.95
F1, F2	7-segment display, RS 276-075	2.58
T1	12V center tap transformer RS 276-1352	5.79
RD1, RD2	50V 1A rectifier diode	.20
Cf	2200 µF 16V JDR Microdevices	.70
Reg	7805 voltage reg +5V, 1 amp	.30
Resistors	6 pull-up 2.2kΩ	.60
C5–C9	blocking cap 0.1 µF, SSS 10/$1	1.00
J1–J5	BNC panel jack, RS 278-105	6.95
R1–R32, R35–R48	330Ω ¼-W, RS 271-1315	3.90
DR1, DR2	switching diode 1N914 or equiv.	.20
XR1	xtal osc resistor 1.8kΩ ¼-W, RS	.19
XR2	xtal osc resistor 560Ω ¼-W, RS	.19
XC1	xtal osc capacitor 20 pF, RS	.39
Case	LMB, etc., size to fit PC board below	7.00
IC board	RS 276-191, 4.5" x 9.5"	5.46
Red Plastic	display cover/light filter	.50
	Total	$68.93

RS refers to Radio Shack; SSS to Solid State Sales, PO Box 74D, Somerville MA 02143, (617) 547-7053, ORDER (800) 343-5230.

If you can't find a case large enough for the circuit card, you can use two or three smaller boards, and a Radio Shack case.

I know of no source for the red plastic filter to cover the display area. Radio Shack no longer sells it. I used a strip salvaged from an old digital clock.

PACKET TALK

Latest in Digital Hamming

Brian Lloyd WB6RQN
5712 Stillwell Road
Rockville, MD 20851

We Missed You!

After a one-year hiatus, Packet Talk is back onto the scene! By way of re-entering the field, I became involved in helping to put last month's packet issue together (no small task). In any case, now, as before, your comments and suggestions are welcome! You can can reach me at the above address, or via usenet or internet as brian@wb6rqn.uucp; or via packet bulletin board as wb6rqn@wa3znw; or on CompuServe as 73207,3064.

Broadcast Packet

If you spend any time on packet radio, you have probably used a bulletin board system at one time or another. If you look at what is stored on the BBS, you quickly notice that most of the messages are bulletins addressed to all@usa or the like. The bulletin boards are efficiently programmed to send bulletins between themselves once and only once. It doesn't work this way, however, for the end users. And that limitation has become a real problem for channel loading.

Imagine that there is a very busy BBS near you. This BBS regularly serves 100 users. A 5K bulletin arrives regarding a very interesting topic, and every user decides to read the bulletin. This means that this simple 5K bulletin will be transmitted over the air 100 times, once to each user. This equals 500K of data. At the equivalent data rate of 500 bits per second (you can't get actual 1200 baud throughput because of turnaround delays and the like), this would be 133 minutes of air time. At that rate, it's not long before there aren't enough hours in the day to handle the traffic. This begs the question: Is this really the best way to distribute bulletins? No!

Broadcast Protocol

Let's review the above more carefully. When the first user requests the bulletin, the BBS broadcasts the bulletin into the ether. If the other 99 users had their TNCs on and were capturing the data on disk, they would end up with their very own copy of the bulletin. Now all we need is a mechanism that will allow the few stations that didn't receive the entire bulletin to request retransmission of the parts they missed. Pretty simple, eh?

The key to making this work is a special broadcast protocol that would reside on top of AX.25. The protocol works by breaking the bulletin down into *segments.*

Each segment must identify the bulletin it belongs to and its position within the bulletin. There probably should be a field that identifies the type of bulletin so that each station stores only bulletins the operator is interested in. Also, the size of the bulletin should be indicated so that the computer can decide if there is room for the entire bulletin or not.

The Segment Header

The segment header might contain:

1. Bulletin ID.
2. Bulletin type.
3. Total number of octets (bytes) in the bulletin.
4. Command code.
5. Segment offset in octets (where this segment begins relative to the beginning of the bulletin).
6. Segment size.
7. Segment data (bulletin text).

The Bulletin ID is a string or number guaranteed to be different from any other Bulletin ID. The Bulletin type code indicates the general subject; for example, there could be a code for NTS traffic, a code for BBS sysops, etc. The total number of octets tells the receiver how long the entire bulletin will be. The receiver compares this value with the amount of segment data received to determine when the entire bulletin has been received.

The command code differentiates a bulletin transmission from a request from a receiver for retransmission of a segment. A zero (0) in the command means that a segment is being transmitted, and a one (1) indicates a request from a receiver to retransmit a segment. The segment offset tells where this segment begins relative to the beginning of the bulletin. If the bulletin sender is transmitting segments 200 octets long, the first segment would have an offset of 0, the second an offset of 200, the third an offset of 400, and so forth. The segment size tells how many octets are in the segment data.

Sending and Receiving

The sender sends the entire bulletin without stopping. The receivers copy as much of the bulletin as they receive while keeping track of any segments that they miss. After the sender is finished, it unkeys. Any receivers that need a segment (fill-in) then wait for a while before requesting the segment again. The request for a retransmission looks like a segment with no data. The bulletin ID is given and the command code is set to 1 (request for retransmission). The segment offset and the segment size tell the original sender which segment to re-send. If anyone else also needs that segment, and they hear the retransmission, and they will not need to request it again.

Since the bulletin ID is unique, the receiver can request a retransmission or fill-in much later, even if the sender has sent other bulletins in the meantime.

I would like to receive some feedback from the packet community about this protocol proposal. With the burgeoning packet activity on HF, VHF, UHF and above, there appears to be a significant need for reliable and efficient broadcast data distribution. Since this service could run on top of unconnected (UNPROTO) AX.25 packets which still provide error-free transmission, you could even distribute new computer software with it.

Networking Packages Revisited

First off, let's get the controversial duo out of the way. For those out of the know, Nord><Link produces a shareware networking package—TheNet—which is virtually identical to NET/ROM, marketed for $60 per NET/ROM chip by Software 2000. Software 2000 has long been claiming that Nord><Link has pirated their software, and Nord><Link continues to stoutly deny the charge. This imbroglio shows no signs of abating or tending toward resolution.

If you're in the market for a packet networking package, *neither* NET/ROM nor TheNet may be your best choice. Listed below are software packages which are feature-competitive to NET/ROM, and yet are much cheaper because most are shareware. Although TheNet is also shareware, if Ron Raikes and Software 2000 hold the copyright on NET/ROM, they could conceivably bring a successful suit against any user of TheNet in the United States.

"... neither *NET/ROM nor TheNet may be your best choice.*"

ROSE, TexNet, PC/Node, and KA9Q Net

The first alternative is the RATS Open System Environment (ROSE) switch. The ROSE switch is a ROM that plugs into a TNC and turns it into an X.25 packet switch. The drawback is that the ROSE switch isn't compatible with NET/ROM. On the other hand, it will perform the same function. Information on ROSE is available from Thomas A. Moulton W2VY, 9 Rosalie Avenue, Clifton NJ 07011.

TexNet, one of the cleanest packet networking packages, runs on a special Node Control Processor (NCP). It includes both low speed (1200 baud) and medium speed (9600 baud) ports. Like ROSE, TexNet uses its own set of protocols, so it is not NET/ROM compatible, either. To get information on TexNet, contact TPRS, PO Box 831566, Richardson, Texas 75083.

Another alternative, PC/Node, written by John Wiseman G8PBQ, runs on IBM-PC compatible computers and is fully NET/ROM compatible with multiple ports. PC/Node also supports a W0RLI or a WA7MBL BBS in the PC at the same time that PC/Node is running.

My personal favorite alternative to NET/ROM is the KA9Q Net program. Net is NET/ROM compatible, and it runs TCP/IP as well. Net runs on several types of computers, including the PC, the Commodore Amiga, the Atari 520, the Apple Macintosh, and just about every UNIX™ system. At this writing, Net was being ported to the AEA PS-186. Net is available on 5¼" disks from Tucson Amateur Packet Radio, Inc., PO Box 22888, Tucson, Arizona 85734. 73

HOMING IN

Joe Moell KØOV
PO Box 2508
Fullerton CA 92633

Winning Foxhunts with TDOA

My last column introduced you to Time Difference Of Arrival (TDOA) RDF methods. There, I described how a narrow aperture TDOA system uses two or more vertical antennas spaced less than a half wavelength apart. The relative differences in distance between each antenna and the transmitter cause phase differences in the signals into the receiver from the antennas.

Switching back and forth rapidly between the two antennas gives a superimposed tone on the discriminator output of an FM receiver due to these phase differences. A null in the amplitude of this tone occurs when the antennas are equidistant from the source; at that orientation the transmitter is in a direction perpendicular to the plane of the antennas.

A TDOA RDF set gives very sharp bearing indications, compared to the broad lobe of a yagi or quad. It's smaller than a beam for the same frequency, so it's easier to use on foot or mobile. You saw last time how easy it is to build the Handy Tracker, an effective TDOA RDF set for VHF. This month, we'll look at TDOA sets you can buy, complete or in kit form, and compare them to the Handy Tracker.

What's on the Market?

The first TDOA VHF RDF unit for ham radio was the Double Ducky, by David Geiser WA2ANU, described in *QST* over eight years ago. The Double Ducky is still available in kit form from Circuit Board Specialists for $27. Since then, similar units have come on the market. The Vector-Finder, introduced by Radio Engineers Company last year, is well packaged. It is intended primarily for boaters and includes a compass in its rather steep $125 price. The most recent entry is the Handy-Finder from North Olmsted Amateur Radio Depot. It just came out this summer, and is available in kit form for $25.

These three commercial TDOA units all give a very sharp line of bearing, but they have a basic problem. In many hunt situations, it's a fatal flaw. They have only a figure-8 pattern, which gives 180-degree bearing ambiguity. That's right, they give you two possible directions for the hidden transmitter, not one.

How do you tell which of the two figure-8 nulls is the one to follow?

The sellers of these units suggest that instead of walking or driving along the bearing line toward (or away from) the transmitter, you should move perpendicular to the line of bearing for a distance, then take another bearing and triangulate the two bearing lines on a map. They call this a "space diversity technique."

Space diversity works, but it's a very inefficient way to do transmitter hunting. You certainly wouldn't want to use that method when mileage or time is the criterion for winning the hunt. And if you were in an emergency situation, you wouldn't want to be waiting for someone to rescue you that way!

As a competitive hunter, I want to keep moving as directly as possible toward the fox at all times. I don't want to add mileage by jogging back and forth or circling in if I can avoid it. That's why I added a cardioid pattern mode on the Handy Tracker. The cardioid mode resolves the 180-degree ambiguity quickly, and that makes the Handy Tracker clearly a better RDF unit.

"A TDOA RDF set gives very sharp bearing indications, compared to the broad lobe of a yagi or quad."

Photo A shows a 2 meter model of the Handy Tracker that uses a double-male BNC adapter to mount it directly on top of a handheld transceiver or scanner. All parts are inside the shielded enclosure made of copper-clad board, except for the batteries. Two batteries are in clips on the bottom near the ends. This helps balance and stabilize the unit on the handle-talkie, and insures that a spare battery is available if needed. (Anybody want to talk about marketing it? Call me.)

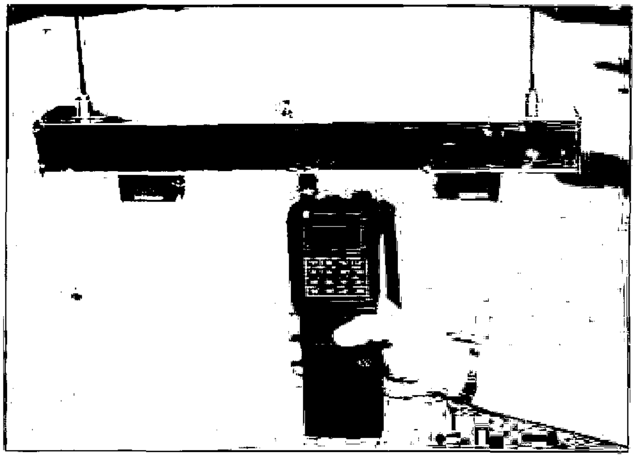


Photo A. This 2 meter version of the Handy Tracker fits right on top of a hand-held transceiver or scanner and can be rotated on the BNC connector to take bearings.

Left or Right?

Several experimenters have worked on ideas for resolving the figure-8 pattern ambiguity by adding visible or audible left-right indicators.

With them, you don't have to spin the unit and listen for the exact null in the superimposed tone. Instead, you turn the unit left when you get a left indication, and right when you get a right indication. At the exact left/right cross-over, you're aimed at the hidden transmitter.

The polarity of the pulses out of the FM receiver's discriminator stage gives left/right information, but it's tricky to extract it. I have tried some of these polarity extraction circuits, both published

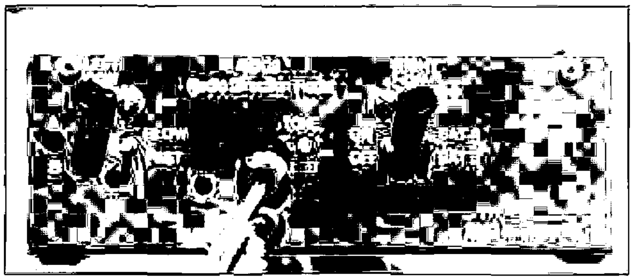


Photo B. Control panel of the SuperDF by BMG Engineering. WD6Y added these hoods to the LEDs on his unit to make them easier to see in bright sunlight, and drilled holes for access to internal controls.

Manufacturers of TDOA RDF Sets for Ham Radio

BMG Engineering Depot 9935 Garibaldi Ave. Temple City CA 91780 (818) 285-6963	North Olmsted Amateur Radio 29460 Lorain Rd. North Olmsted OH 44070 (216) 777-9460
Circuit Board Specialists PO Box 969 Pueblo CO 81002 (719) 542-4525	Radio Engineers Company 3941 Mt. Brundage Ave. San Diego CA 92111 (619) 565-1319

and unpublished. They usually work OK for hunting dead carriers, but if there is any modulation on the fox's signal, the indicator is not reliable or stops working altogether.

Fortunately, Russ Andrews K6BMG developed an indicator system, using synchronous detection, that works well even when the signal is modulated. Photo B shows his control box. In addition to LED indicators for left and right, there is a tone indicator mode. In that mode, the polarity sensing circuit forces the tone to make a noticeable change in pitch at cross-over. Low tone is a left turn indication and high tone is a right turn indication. The tone mode is easier to use while driving, and it saves battery power.

K6BMG sells his TDOA RDF set, called the SuperDF, in kit or wired form through his company, BMG Engineering. There are two antenna models, one for VHF (50–260 MHz) and one for UHF (100–550 MHz). Each uses vertical dipole antennas. Cost of a complete setup for use with your 2 meter receiver or transceiver is $135.60 for the control unit (kit price) plus $33.50 for the least expensive antenna set.

The left/right indicators on the SuperDF make it easier and faster to use than any of the other TDOA RDF sets, especially when the antenna and control unit are separated for hunting in a vehicle. If you have ever thought about T-hunting from a small airplane, consider mounting the two SuperDF antennas to the aircraft windows, keeping them a half wavelength or less apart. Then simply follow the left-right indications to fly right over the transmitter.

Another advantage of the SuperDF over the Handy Tracker is that the SuperDF works over a wide frequency range. BMG Engineering did tests demonstrating an accuracy of ±3.5 degrees from 110 to 260 MHz with one antenna set, when no reflections or multipath were present. The cardioid pattern mode of the Handy Tracker is limited to coverage of just one ham band, though you could add switching for additional lines to increase its range somewhat.

Field Evaluation of the SuperDF

The SuperDF is an excellent performer on vertically polarized signals.

K6BMG and I disagree, however, on its performance when the fox is horizontally polarized. Russ says he gets good horizontal performance by holding the unit overhead with the dipoles horizontal; he calls this the "pancake mode." I have tried this on competitive hunts, and I've also tried holding it out forward with the antennas at a 45-degree angle from vertical. Sometimes these positions gave good bearings on horizontal signals, but as often as not, they led me astray.

"The left/right indicators on the SuperDF make it easier and faster to use than any of the other TDOA RDF sets . . ."

The synchronous detector must track the time delay of the FM receiver circuits. So unlike the Handy Tracker and other TDOA units, the SuperDF control unit may have to be readjusted when you're changing from one receiver to another receiver. This is no problem if you use it with only one radio, but it can be an annoyance if you use separate radios for vehicle hunting and on-foot sniffing.

You can have problems using the SuperDF if your receiver is not dead on-frequency, or if the IF and discriminator are out of alignment. Off-frequency signals produce distorted and sometimes inverted pulses. Thus, it's very important that the receiver be tuned exactly to the transmitter frequency for use with the SuperDF.

I have attempted to use the SuperDF with scanners for hunting outside the ham bands. Sometimes this worked well, but occasionally there were severe bearing errors caused by misalignment of the scanner or inability to set the scanner frequency to the exact transmitter frequency. Avoid the problem by testing your setup on a known signal source before looking for a hidden transmitter, performing receiver realignment if required.

I liked using the SuperDF in my initial tests, particularly for on-foot sniffing of low-power transmitters too weak for use with an amplitude-based sniffer. But I wished that it had a zero-center meter for left/right indication in addition to the two LEDs and the tone mode. The swing of a meter is easier for an experienced hunter to interpret in multipath than the flashing of lights. The meter also makes it quick and easy to peak the synchronous detector output when switching to a different receiver. So I taped a 1½-inch edgewise panel meter to the top of the SuperDF cabinet and used the circuit provided in the manual to drive it. If you have a SuperDF, give it a try.

Pitfalls of TDOA

All of the TDOA units are remarkably sensitive, but don't expect them to compete with a long yagi or quad when the signal is very weak. They are not the units of choice for starting the southern California 2 meter All-Day hunt, where the transmitter is typically 200 miles away. In severe multipath situations, they will be fooled, but you can usually still use them successfully if you keep moving and average out the readings. The slow response mode on the SuperDF is a big help in this regard.

I recently buried the transmitter on a Sunday afternoon hunt in an irrigation hole along the almost-green belt between the Santa Ana River and a row of bushes. Only the slim "rubber ducky" stuck out of the ground, camouflaged in a plant. Hunters with TDOA RDF sniffers would start at the riverbank, take a bearing, and then walk along the bearing line right over the transmitter into the bushes. When they didn't find it there, they'd step out, take another bearing, then walk the bearing line right over the transmitter again, onto the riverbank.

Without signal strength information, these hunters couldn't tell when they had reached the transmitter. Moral: Consider carrying along a field strength meter in addition to your TDOA sniffer so you can tell when you're very close to the fox. If you can't do that, stop much more often to take bearings and be sure you haven't gone too far.

A TDOA RDF set or sniffer is an important addition to your T-hunt arsenal. Take your pick, build or buy, then go out and find those hidden transmitters! 73

QRP

Low Power Operation

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Direct Conversion Receivers

Whenever two or more QRPers get together, the conversation turns to direct conversion (DC) receivers. I've mentioned these receivers before, and I've received a lot of mail on them, so this month we'll take a closer look.

What is a DC or "synchrodyne" receiver? In a DC receiver, a separate oscillator supplies the injection signal to the detector. The oscillator, in most cases, operates at the receiver's frequency. I call this oscillator the VFO, but some people call it the variable beat-frequency oscillator (VBFO). The VBFO replaces the tunable local oscillator used in superheterodyne receivers. The output of the VBFO is directly injected into the product detector. The product detector functions somewhat like the mixer in the superhet receiver.

How the DC Receiver Works

In most cases, and particularly on 80 and 40 meters, the incoming signal from the antenna is fed directly to the mixer. In better designs, the use of a tuned input will help in selectivity. We'll look a bit closer at this later on, but for now, let's just place the antenna directly to the mixer. The VBFO, or as I call it the plain 'ol simple VFO, is mixed with the incoming signal. This produces two outputs. Of the two outputs only one is within the audio range. The output is the sum and difference between the incoming signal and the VFO.

Look at it this way. Suppose you tune the VFO to 7040 MHz. Someone is calling CQ on 7041. The VFO and the incoming signals mix. The output is 1 kHz and 14081 kHz. The 14081 kHz is too high to use, and is filtered out. This leaves only the 1 kHz AUDIO note. This audio frequency is then amplified. At this stage, the DC receiver gets its gain, in the audio frequencies. Gain of over 100 dB have been used in DC receivers. In better designs, the use of audio filters provide the means of selectivity, or picking out the desired station.

It works quite simply. There are no IF frequencies or IF cans to mess with. The signal is mixed and the output is audio. Now for the bad news.

Tricky Tuning

Let's go back to our VFO sitting on 7040 MHz. Say the station we heard was on 7039 MHz; that station would also produce the SAME 1000 kHz tone. Now I don't know about you, but my ears can't tell the difference between two signals producing the same output from the mixer. This brings us to the biggest problem with DC receivers: lack of single signal reception. When tuning through the band, we heard TWO signals from each station. There are two signals on either side of zero beat, and nothing can eliminate this. Circuits attempting to avoid the problem soon become just as complex as the superhet receiver.

Since the DC receiver can't distinguish between the incoming signals, tuning for the correct one can be a real chore. There are, however, two basic "fixes." One, you can tune down from zero beat to produce two slightly different beat tones. Two, you can zero beat the station, then move off slightly to produce an audio tone. In either case, users of DC receivers begin to find a fix that will work.

When the audio circuit includes a filter centered around the common 750 Hz frequency, tuning becomes real fun! I use the zero-beat-and-move method, which works best for me.

Since the VFO operates very close to the desired receive frequency, it did not take too long for some QRPer to connect the output from the VFO to a low power transmitter. Instant transceiver! Instant problem!

Direct Conversion Designs

These run the entire spectrum from really bad to outstanding. The HW-7 receiver, for example, is the pits. Both the HW-7 and the HW-8 use a DC receiver.

We've been listening for some time to a Delaware station on 40 meters with your hamfest special HW-8. Since you and I both know there are only three active hams in that state, you would like to work him. You tune him in till he's centered in the filter. A good solid 5NN. He signs his call and you send him yours. Nothing. You try again. Nothing. One more time. Nothing. What's wrong? You're on the wrong side of zero beat. He can't HEAR you.

The VFO is sitting on 7039 MHz. Delaware is calling on 7040. You tune for max audio from the filter, but you're on the low side of his signal. This happens too often to the new user of an HW-8. The HW-8 uses what is known as "receive high—transmit low" tuning scheme. When the HW-8 goes to transmit, the frequency is down-shifted about 750 Hertz. To make matters worse, most HW-8s don't shift the same. The HW-8 depends on the load from the transmitter to move the VFO. A HW-8 can off-shift as much as 3 kHz!

Yup, there is a mod to correct this problem, but you should be aware that it does happen. If you tune from the low side up, find that Delaware station calling CQ, and transmit, you'll be about 1500 kHz BELOW his frequency. He'll never hear you. So to work the station, you have to tune from the high end of the band DOWN to the station. When the HW-8 goes to transmit, 750 Hertz lower, he'll hear us.

> ***"I don't care for a dash of AM with my CW."***

Problems with Direct Conversion

Things really get messy when the other operator uses a highly filtered superhet receiver. Most operators don't use the RIT to move about, looking for stations calling them. Most SSB superhet transceivers offset the transmitter differently. This causes much trouble for the HW-8 user, if the transceiver is tuned improperly.

As if that were not enough, the gain of the DC receiver is produced within the audio chain, and all that gain is hard to control. Many DC receivers are microphonic. Slight movement of anything will be picked up and amplified by the audio circuits. While using DC receivers, I've heard ants walking on the table.

Direct conversion receivers are prone to pick up AM signals from anywhere. Heaven help you if you live near an AM broadcast station. I don't care for a dash of AM with my CW.

The lack of selectivity can really be a problem. Since we must use audio filtering for selectivity, the use of low noise transistors and ICs are a must. A high noise factor can mask even the strongest stations.

The use of AC operated power supplies can cause all kind of hum to be picked up by the audio circuits. This is called common-mode hum. Basically, energy from the VFO gets into the power supply. The power supply radiates the signal back out via the supply lines. The antenna picks up the signal and the whole thing repeats. When you're operating on battery power, you don't have to worry about common-mode hum.

Admirable Features

With all these problems, who in their right mind would operate, let alone build, one? Let's look at several good points of the DC receiver. They are extremely easy to build and get operating. Sensitivity is outstanding; a good DC receiver can surpass many a superhet in sensitivity. Signals seem to jump out of the speaker. Crisp clear audio makes for superlative listening pleasure. Since the VFO operates near the operating frequency, transceiver operation is easy. Because of the low part count, battery operation, and thus portable operation, is effortless. As you can see, the DC receiver does in fact have a lot going for it. Since we've looked things over this month, we'll start to build some simple receivers. Keep the soldering iron at hand.

Also, I'm still looking for mods for the HW-7, HW-8, and HW-9 for the third edition of the *Hot Water Handbook*. Send them to me and if I use them, you'll receive a free copy of the book.

Don't forget about the field day photos. Have yet to receive any. If you want bragging rights, here's your chance.

What's coming down the line? Lots of good stuff! Right now, I'm off for some portable QRP on the bike. 73

LOOKING WEST

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At Last: No-Code Ticket Support from Newington!

The ARRL Board has said yes to a no-code ticket! The Leagues' Board of Directors met Friday and Saturday, July 21 and 22, in Windsor Locks, Connecticut. After extensive and sometimes heated discussion, they agreed by a close 9 to 6 vote on a proposal recommending a codeless class of amateur license, which they will present to the FCC as a petition.

Under the ARRL plan, this would not be an easy license to obtain. The testing would be more rigorous than that now required for a Technician class ticket. The examination, given through the VEC system, would consist of Element 2 and an expanded Element 3A, including questions related to Morse code.

To upgrade to Technician, the new licensee would only have to pass a VEC 5 wpm Morse code test. The proposal does not address the question of what will happen to the Novice license as we know it today.

Communicator Class License

Callsigns would be assigned from the Group D callsign block. This would make it impossible for currently licensed or higher grade amateurs to tell a code-free from a code-hazed amateur without consulting a call directory. The idea is to minimize any chance of license class bigotry and isolation of the no-codes. Frequency privileges would be 220 MHz and above, with output power limited to 250 watts. The no-code licensee would not be permitted to act as control operator of a repeater or auxiliary station, but he could legitimately own and operate a repeater or remote under the higher class license of another amateur.

The ARRL directors think the best name for the proposed ticket is the Communicator class, which should not be confused with an unpopular FCC proposal in 1974 to create a new class of license also called the Communicator.

The League's no-code license proposal is probably in the hands of the FCC by now. The FCC has the option of issuing a Notice of Inquiry or, if it deems appropriate, going directly to a Notice of Proposed Rule Making on the Creation of a Codefree Entry Level Amateur License.

If At First You Don't Succeed...

Unlike the 1983 attempt to create a code-free entry level license, this time the concept will probably become reality. While there is bound to be some opposition from the amateur community, at least a narrow majority of the ARRL leadership has gone on public record as favoring the idea. Well before an anti-no-code grass roots campaign could start, League President Larry Price W4RA placed his head on the political chopping block by creating the League's No-Code Advisory Committee. Price was astute enough to select George Wilson W4OYI to chair the committee, and to direct that it be composed of representatives from every facet of the amateur community, including the amateur support industry.

Last spring, the Committee released findings favorable to such a new license. Less than two months later, the ARRL Board went on record as being in favor of such a license.

The no-code concept also has the open support of powerful groups in the hobby. This includes AMSAT-North America, Tuscon Amateur Packet Radio Inc. (TAPR), the Amateur industry Association, the National Amateur Radio Association, the International Amateur Radio Network, and most amateur publications. While several anti-no-code organizations have appeared on various packet BBSs—primarily in the northeastern part of the country—none of these appears to have wide support as yet.

When Will It Happen?

The real question appears to be not whether, but when, there will be a no-code license. If the FCC elects to go directly to Notice of Proposed Rule Making (NPRM) or, if the ARRL proposal is submitted as an NPRM, in theory no-code could become a reality by year's end. It's best, though, to not hold your breath. Between one and two years is more likely, and even longer if the matter starts as a Notice of Inquiry. If all goes as most experts suggest, look for an official no-code license announcement at the 1991 Dayton Hamvention, the traditional place and time for the ARRL to release major changes or findings.

As to the final rules governing a code-free license, the ARRL proposal is middle-of-the road. But it also places the Commission in a strange bind because the FCC has possibly a dozen or more other code-free license proposals to consider. These have come from just about every arena in the amateur community. Many are far more liberal in both testing requirements and privileges granted. In making any decision the FCC must give equal consideration to each of these proposals.

Who Voted How

It will be interesting to see just how much opposition there really is to no-code. At different times over the next two years, the entire ARRL Board of Directors stands for re-election. ARRL Directors voting in favor of no-code were Hugh Turnbull W3ABC, Atlantic Division; Howard Mark W0OZC, Dakota Division; Steve Mendelsohn WA2DHF, Hudson Division; Tom Frenaye K1KI, New England Division; Rush Drake W7RM, Northwestern Division; John Kanode N4MM, Roanoke Division; Marshall Quiat AG0X, Rocky Mountain Division; Frank Butler W4RH, Southeastern Division; and Jim Haynie WB5JBP, West Gulf Division. In opposition to no-code were Directors Ed Metzger W9PRN, Central Division; Joel Harrison WB5IGF, Delta Division; Leonard Nathanson W8RC, Great Lakes Division; Paul Grauer W0FIR, Midwest Division; Rod Stafford KB6ZV, Pacific Division; and Fried Heyn WA6WZO, Southwestern Division.

Are We All Ready?

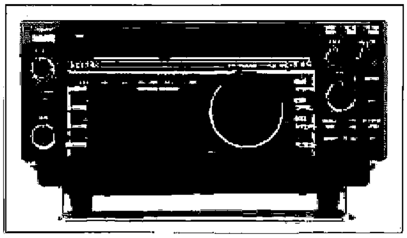
If, as the anti-no-code "packet propagandists" claim, there is heavy sentiment in the ARRL rank and file that they were sold out on no-code by their leaders, we should see a major shift in ARRL leadership over the next two years. However, except for those individuals who may not run for office again, I'm willing to bet there will be little change in the ARRL directorate attributable to the no-code issue. The time for this license class has long been overdue. 73

1989 Holiday Wish List

It's the same tough question every year—what to put under the tree for the OM/YL/harmonic. Before heading out to the "candy store," check out some of our picks for good-value gear in 1989!

HF RIGS

ICOM IC-735



The IC-735 is a compact and full-featured HF transceiver with general receiver coverage. It measures 3.7" (H) x 9.5" (W) x 9.4" (D), making it well-suited for mobile operation in cars, airplanes, and boats, as well as for base station operation. It covers all amateur HF frequencies from 1.8 to 30 MHz, and has continuous receive from 100 kHz to 30 MHz. The 735 covers SSB, CW, FM, and AM modes. The rear panel has ports for AFSK operation.

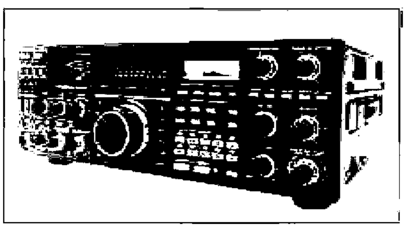
The IC-735 has three scanning functions: memory scan, programmed scan, and mode scan. In addition, it has two VFOs and tunes to 10 Hz resolution, suiting it ideally for most modes, even HF packet. For lovers of CW, the 735 supports both break-in (QSK) and semi-break-in operation. A DC cable comes with it for mobile operation.

The IC-735 retails for $1150. Contact *ICOM America, Inc., 2380 116th Ave. N.E., Bellevue WA 98009-9029, (206) 454-7619*, or circle Reader Service number 220.

KENWOOD TS-940S

The TS-940S is a full-featured HF transceiver that provides AM/FM/FSK/SSB/CW operation for all amateur bands from 160 to 10 meters. General receiver coverage ranges from 30 kHz to 30 MHz, with all-mode transmitter operation on all HF amateur bands. All switches and dials on the front panel are easily accessible.

The receiver has continuously variable IF bandwidth. In SSB mode, the lower and upper filter skirts are independently variable, providing versatile "low-cut" and "high-cut" operation. In CW and RTTY mode, there is a single knob to vary the width of the passband. In CW mode, you can also vary the BFO injection frequency, thus allowing you to pick a desired CW tone while keeping the signal in the center of the IF passband. Optional CW filters include those for 250 Hz and 500 Hz. The 940S has a multi-function liquid crystal display that displays memory frequency content, time, and IF bandwidth.

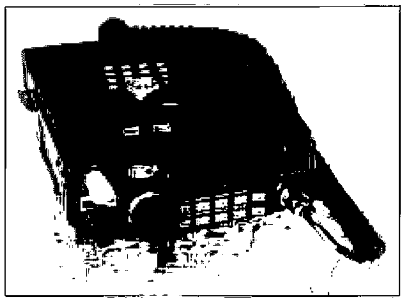


The TS-940S retails for $2500 ($2270 without optional automatic antenna tuner). Contact *Kenwood USA Corp., PO Box 22745, Long Beach CA 90801-5745, (213) 639-4200*.

MOBILE RIGS

YAESU FT-790RII

The FT-790RII is an SSB/CW/FM 70cm transceiver for 430–450 MHz operation. It uses the same accessories as the 690R and 290R, is the same size, and shares much the same control setup.



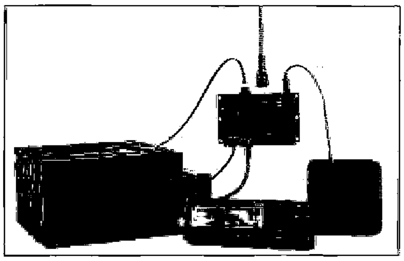
The FT-790RII has 10 memory channels, and offers three scanning options: VFO scanning, memory scan, and programmable scan. It also has priority channel operation, and duplex operation for non-standard offsets. This transceiver covers the 70cm band in two segments: 430–440 MHz, and 440–450 MHz. Three tuning rates are available for each mode (SSB/CW—25 Hz, 100 Hz, and 2.5 kHz, FM—12.5 kHz, 25 kHz, and 50 kHz).

If you like to operate 70cm portable anywhere—camping, at the beach, on a boat—this transceiver belongs on your wish list. Its small size lends itself to any number of operating situations, and it packs a lot of punch for its size.

The FT-790RII retails for $681. Contact *Yaesu USA, 17210 Edwards Road, Cerritos CA 90701, (213) 404-2700*, or circle Reader Service number 222.

ICOM IC-901

The IC-901 multiband HF/VHF/UHF/microwave mobile transceiver improves on its predecessor, the IC-900. It comes standard as a dual-band FM transceiver (2 meter and 440 MHz), but you can add up to to four more band units for 10m, 6m, 220 MHz, and 1.2 GHz. There is also a band unit available for 2m SSB and CW.

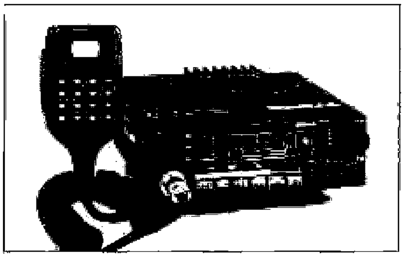


Like the IC-900, the IC-901 is comprised of band units, an interface box, and a control head. Using fiber optic cables, you can remote the band units and interface box (e.g. to the trunk) and mount the control head within easy reach. This keeps the majority of your station out of sight, reducing the chance of theft. You can also install the control head directly to the interface box for a compact transceiver.

Other standard features include an extra-large multi-color LCD that visually displays squelch and volume settings, touch-tone microphone, and sub-audible tone encode/decode for private channel operation.

The retail price for the base system is $1,200. Contact *ICOM America, Inc., 2380 116th Ave. N.E., Bellevue WA 98009-9029, (206) 454-7619*, or circle Reader Service number 223.

ALINCO DR-570T



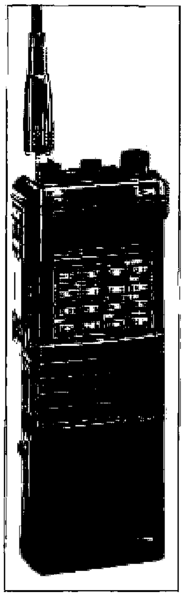
The DR-570T 2m/70cm dual-band mobile transceiver is the successor to Alinco's 24T. It has independent main band and subband operation, which allows full duplex operation, low power, four scanning (memory, programmed, busy channel, and free channel) functions, full reverse operation, priority, call, and ABX functions.

The 37 selectable sub-audible tone frequencies can be called for encode or encode/decode (tone squelch CTCSS), permitting private access. The front panel is easy to read and the large controls are very accessible. The dual function push switches have unique raised patterns on their surfaces to allow the mobile operator to easily tell them apart just by feel. The multi-color LCD display lets the operator know which functions are in operation. The built-in duplexer has a single antenna output for a dual-band antenna. There are plenty of beep and bell tones that give a range of information during tuning—again to allow the mobile op to keep the eyes on the road—but the user can shut them off if desired.

The retail price is in the $500–$600 range. Contact *Alinco Electronics Inc., 20705 South Western Ave., Suite 104, Torrance CA 90501, (213) 618–8616*, or circle Reader Service number 224.

HANDHELDS

ICOM IC-32AT

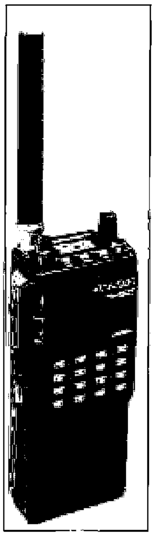


The IC-32AT 2m/70cm dual-band HT offers five watts of power output on each band, receives 138–174 MHz, and transmits 140–150 MHz and 440–450 MHz. It features full duplex capability, 40 memory channels, programmable scan, memory scan, and an optional UT-40 tone squelch unit.

This HT also offers DTMF keyboard access with direct frequency entry from the keyboard, a repeater input monitor, priority watch, and a dial select function. Plus, it's splash resistant—rubber gaskets protect the transceiver from dust and moisture.

The retail price for the IC-32AT is $630. Contact *ICOM America, Inc., 2380 116th Ave. N.E., Bellevue WA 98009-9029, (206) 454–7619*, or circle Reader Service number 225.

KENWOOD TH-25AT



The TH-25AT is a full-featured programmable 2m HT. It's small, rugged, and the case is water resistant.

The LCD, mounted on top, has a bar graph S-meter which also functions as a battery voltage indicator during transmit. It has a lock switch to prevent accidental frequency changes. The LEDs are surprisingly bright, making the display easy to read in the dark.

A 600mAh NiCd battery comes with the TH-25AT. There is an automatic battery-saver circuit, and an optional AA battery case. Plus, there's an automatic power-off circuit which shuts off the rig after 59 minutes of inactivity.

The unit receives from 141–163 MHz. It has fourteen memories, band scan functions, and memory lockout.

The TH-25AT retails for $330. Contact *Kenwood USA Corp., PO Box 22745, Long Beach CA 90801-5745, (213) 639-4200*.

YAESU FT-411

The FT-411 micro-sized HT provides up to five watts output across the 2 meter band. It has 49 memories and VFOs controlled by a 16-button backlit keypad.

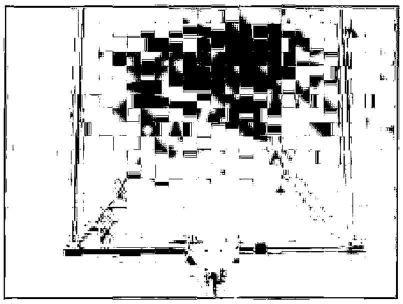
All memories store repeater offsets or separate TX/RX frequencies, and CTCSS tones when the optional FTS-17 Tone Squelch Unit is installed. A unique feature of the 411 is its ability to store DTMF tone series in macros, allowing you to dial a number on an autopatch with a single keystroke! The keypad serves as a DTMF encoder during transmission. 10 DTMF memories can be used to store 15 digits each.

Other FT-411 features include: busy channel lockout; subband (programmable), and selective memory scanning; priority channel monitoring; 1 MHz up/down stepping; automatic repeater shift (±600 kHz) in the repeater subbands; and a top panel rotary dial for memory and frequency selection.

The FT-411 retails for $406. Contact *Yaesu USA, 17210 Edwards Road, Cerritos CA 90701, (213) 404–2700*, or circle Reader Service number 226.

ANTENNAS/TUNERS

DELTA LOOP DL-102



The DL-102 is a V-shaped 10m beam with the element tips connected together with copper wire. A 5-foot boom supports the "arms" (elements). The elements are attached to the boom by heliarc welded element "horn" clamps. A mast mounting bracket attaches the boom to the supporting mast.

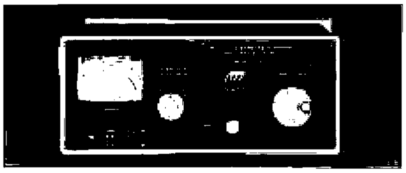
This antenna exhibits the same general broadband characteristics and electrical properties as full-wave loop antennas such as the quad. Some of the other interesting specifications are weight: 21 lbs., element arm length: 12 ft., boom length: 5 ft., turning radius: 7 ft., surface area: 2.9 sq. ft., and element spacing: ⅛ wavelength. The Delta Loop also has an adjustable gamma match (rated to 2kW), with an input impedance of 50Ω. The gamma match is factory pretuned and wired. All you need to do is connect your coax to the bracket.

This antenna is built to last. All of the tubing is 6061-T6 aluminum. There are no castings, and all the hardware is mil-spec stainless steel.

Another nice feature of the DL-102 is that it has a surface area of only 2.9 square feet. That, plus its relatively light weight, allows you to use a rotator with the Delta Loop as light duty as a good TV antenna rotator.

Suggested retail price for the DL-102: $300. Delta loops for 15m and 20m are also available. Contact *Delta Loop Antennas, 12 Brush Dr., PO Box 8063, New Fairfield CT 06812, (203) 746-6368,* or circle Reader Service number 219.

MFJ DIFFERENTIAL T TUNER



MFJ's innovative MFJ-986 Differential-T™ 3kW roller inductor tuner gives you three innovations in antenna tuner technology.

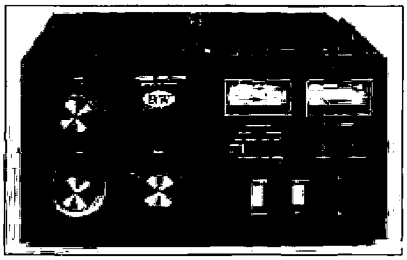
First, you get a differential capacitor that simplifies tuning and gives you minimum SWR at only one setting. Second, MFJ's new peak and average reading SWR/Wattmeter has a new directional coupler that gives you more accurate SWR and power readings over a wider frequency range. Third, a new current balun reduces feedline radiation and field pattern distortion.

This 10¾" x 4½" x 15" unit also gives you a 6-position ceramic antenna switch that lets you select two coax lines (direct or through the tuner), random wire, balanced line, and external dummy load. A three-digit turns counter lets you quickly reset the tuner to operate on your favorite frequency. You also get MFJ's full one-year No Matter What™ Guarantee: MFJ will repair or replace (at their option) your MFJ multi-mode, no matter what happens to it, within that first year.

The MFJ-986 retails for $270. Contact *MFJ Enterprises, Inc., P.O. Box 494, Mississippi State MS 39762, (601) 323-5869 or (800) 647-1800*, or circle Reader Service number 218.

LINEAR AMPS

BARKER & WILLIAMSON PT-2500A HF AMP



The PT-2500A 1.5 kW amplifier is a superb Class AB2 linear amplifier, rated for continuous duty at 1500 watts output. The PT-2500A offers excellent performance for any mode or style of operation, even HF packet.

The PT-2500A uses two Eimac 3-500Z zero-bias triodes, tried and true workhorses in many HF amp designs. There is very little intermodulation distortion (– 33 dB), and the amp has a minimum of 60 percent plate efficiency on all HF bands.

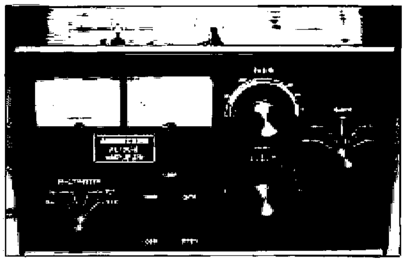
The output circuit is a pi-L design using a 235 pF, 6 kV variable tuning capacitor and a heavy-duty, silver-plated 7 kV rotary inductor, which allows impedance matching over an even greater range than the simpler pi- and L-networks.

Since the PT-2500A uses a grounded-grid (cathode-driven) design, it is well suited for HF linear operations.

The power supply is worthy of a continuous-duty amplifier. Although B & W recommends 230 VAC primary power, the unit will run from 115 VAC if 25–30 ampere service is available.

The suggested retail price is $2175. Contact *Barker & Williamson, 10 Canal Street, Bristol, CT 19007, (215) 788-5581*, or circle Reader Service number 229.

AMERITRON AL-80A



The Ameritron AL-80A delivers over 1000 watts PEP, 850 watts CW, and 500 watts RTTY, with only 85 watts drive. It uses the industry standard 3-500Z tube with a heavy duty tank circuit to achieve up to 70% plate efficiency from 160 through 15 meters The unit is also easily modified to use on 10m. A Pi-L circuit gives smooth tuning and full band coverage, even on 80 and 160 meters. The 80A also features smooth-operating vernier controls.

There are two lighted meters. One gives a continuous reading of the 3-500Z grid current. The other meter is a multimeter that displays plate voltage, plate current, peak RF output, and drive power/ALC detector voltage.

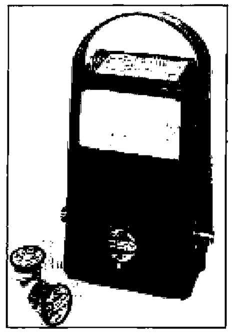
The AL-80A measures 15"(D) x 14¾"(W) x 10"(H). It comes with a two-year warranty. The unit retails for $995. Contact *Ameritron, Inc., 2375 Dorr Street, Toledo OH 43607, (601) 323-9715*, or circle Reader Service number 230.

TEST EQUIPMENT

COAXIAL DYNAMICS 81000A RF WATTMETER

Get Bird quality without paying Bird prices! Coaxial Dynamics' Model 81000A is a handy, portable, and economic wattmeter for measuring RF power. It includes a large, clear, easy-to-read meter scale with a mirrored backing, to eliminate parallax error.

You can choose from a full line of economically priced detecting elements to cover 100 milliwatts to 10,000 watts. The Model 81000A's frequency range covers 0.45 MHz to 2300 MHz. Standard elements are available from 2 to 1300 MHz, others on request. "Quick Match" connectors (for low VSWR) are available in all popular series from Type SMA to 1⅝", both male and female. It is normally supplied with type "N" female. The SO-239 connector is also available.



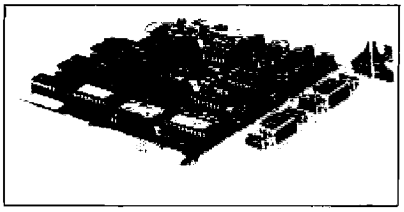
The Model 81000A is available at most amateur radio supply stores. The suggested retail price is $160, with extra elements priced from $50 to $100. For more information contact *Coaxial Dynamics, Inc., 15210 Industrial Parkway, Cleveland OH 44135, (216) 267-2233 or (800) COAXIAL*, or circle Reader Service number 227.

PACKET/DIGITAL

DRSI PC*PACKET ADAPTOR CARD

The DRSI PC* Packet Adaptor (PCPA) is a board that plugs into your IBM (or compatible) and turns it into a complete packet radio communications system. With the PCPA, you no longer need a TNC—the PC* Packet Adaptor has all the functions of a TNC, and more. The software that comes with the board lets you operate it as a TNC, a bulletin board, a Net/ROM node, and a TCP/IP network host.

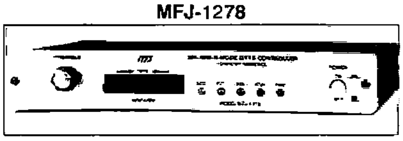
The PCPA board is a half-length card. You can plug it into any slot in any PC/XT/AT-compatible computer system. The board is available in three versions: 1200 bps modem/RS-232 port, no modem/two RS-232 ports, and two 1200 bps modems. You can run up to four PCPA boards in the same PC, and all the boards can share the same IRQ line.



One of the strengths of the PCPA is that it comes with so much software: the basic PC/TNC package; the "BB" bulletin board package by AA4RE; PC/Node; NET/ROM; the BBS package by G8BPQ; and the KA9Q TCP/IP "Net" package.

The DRSI PC* Packet Adaptor retails for $140–$170 (there are three models available). Contact *DRSI, 2065 Range Road, Clearwater FL 34625, (800) 999-0204*, or circle Reader Service number 213.

MFJ-1278



The MFJ-1278 multi-mode data controller supports nine digital modes: packet, AMTOR, RTTY, ASCII, CW, WEFAX, SSTV, Navtex, and full-featured Contest Memory Keyer. It

also offers the new Easy Mail™ Personal Mailbox, the new Multi-Gray Level FAX/SSTV Modem, 20 LED tuning indicator, 32K of RAM, FAX transmitting, and true DCD.

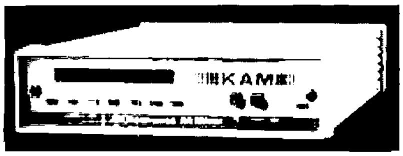
Other features include AC power supply (or use 12 VDC), KISS code, random code generator, independent printer port, lithium battery backup, RS-232 and TTL serial ports, standard 850 Hz RTTY shift, socketed ICs, programmable message memories, software-selectable dual radio ports, and much more—all in a sleek 9½" x 9½" x 1½" cabinet.

Hooking up your MFJ-1278 is easy. All you need is the MFJ-1278, your rig, any computer, the appropriate radio/1278 and 1278/computer cables, and a terminal program. MFJ offers software starter packs, at $24.95 each, for IBM compatible, Commodore 64/128/VIC-20, or Macintosh computers. They include interface cable and software on disk or tape.

You also get MFJ's full one-year No Matter What™ Guarantee. (See page 62, the MFJ-986.)

The MFJ-1278 retails for $280. Contact MFJ Enterprises, Inc., Box 494, Mississippi State MS 39762, (601) 323-5869 or (800) 647-1800, *or circle Reader Service number 214.*

KANTRONICS KAM DATA CONTROLLER



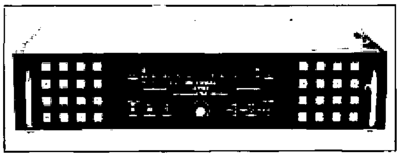
The Kantronics KAM is a multi-mode data interface that encodes/decodes CW, packet, RTTY, ASCII, and AMTOR. It can be used with a personal computer to receive weather facsimile (WEFAX) broadcasts.

The KAM is a modem-sized box, 22.5 x 14.7 x 4.7 cm. The front panel has two push-button controls, one for power and one to select the FM or AM (limiter-less) operation of the HF modem. The rest of the front-panel controls are LED status indicators, plus an easy-to-read green bar graph tuning indicator. The back panel has two radio connectors, a connector for the computer/terminal, and a connector for power.

The KAM comes equipped with two special packet features not found in most other TNCs or multi-modes: a gateway function and a personal mailbox. The gateway function permits the KAM to act as a crossband digipeater when both the HF and VHF ports are enabled. The personal packet mailbox (PPM) lets users or BBS stations connect to the KAM and leave or retrieve messages. In essence, the KAM becomes a small BBS with messages stored in the KAM's memory, rather than on a disk.

If you are looking for a small, low-power, lightweight, all-purpose terminal unit to use with your personal computer, the KAM may be the answer. It retails for $320. Contact *Kantronics, Inc., 1202 E. 23rd Street, Lawrence KS 66046, (913) 842-7745*, or circle Reader Service number 215.

UNIVERSAL M-7000 MULTI-MODE DECODER

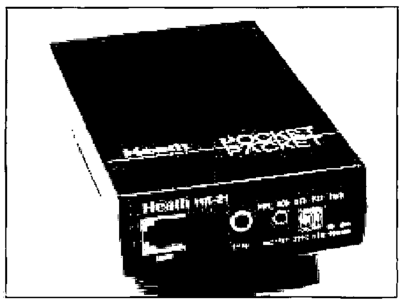


The Universal M-7000 is a sophisticated multi-mode code converter. This dedicated device (no computer required) decodes Morse code, Baudot RTTY, Bit-Inverted Baudot, SITOR A and B, ASCII, and packet. It can also display facsimile in all speeds and IOCs.

Other, more exotic, modes, such as FDM (VFT) 8, 12, 16, and 24 channel, can also be intercepted. Synchronous military modes such as ARQ-M2, ARQ-E, and ARQ-E3 are uniquely available through the M-7000. Other advanced capabilities include Russian Third Shift Cyrillic, Literal Mode, and Databit Mode. Auto baud, auto shift, and auto tuning are supported. Convenience features include diversity inputs, ATC, MSI, UOS, OPI, SelCals, and Autostart. The M-7000 will output to a monitor, printer, or terminal control.

Retail prices are in the $1000 range. Contact *Universal Radio, 1280 Aida Drive, Reynoldsburg OH 43068, (614) 866-4267, or (800) 431-3939*, or circle Reader Service number 216.

HEATHKIT HK-21 TNC



The Heath HK-21 TNC is a compact, self-contained TNC with a built-in personal packet bulletin board system (PBBS). It measures 2½"(W) x 1"(H) x 4¼"(L) with no cables plugged in. With the internal battery pack, the unit weighs about 5½ ounces.

This unit draws very little current. In standard 12 volt DC use, it draws a little less than 40 mA. The optional NiCd battery pack is rated at 120 mAh, and is charged whenever external battery power is applied.

The HK-21's PBBS is quite complete. An outside computer isn't necessary; software and message storage is part of the HK-21.

The HK-21 retails for $220 (plus $18 for the battery pack). Contact *Heathkit, Benton Harbor MI 49022, (800) 253-0570*, or circle Reader Service number 217.

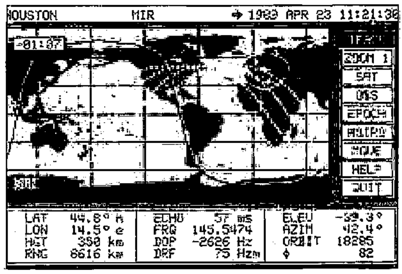
SOFTWARE

INSTANT TRACK

Instant Track is a high-end satellite tracker IBM PClone program that carries a very low-end price. It is full-featured and a joy to use.

The main menu lets you edit your station elements, any of up to 200 satellites in its library, and gives you a choice of functions. The startup screen even gives favorite satellite statuses, so you instantly see if they're up or down.

You can graphically display an excellent Mercator projection of the world, on an EGA/VGA screen, with locations of sun, moon, day/night terminal line, and your bird of choice continuously updated. You can also invoke a



text screen that includes live data for multiple stations, and print a quick-reference operating schedule. After putting in the latitude and longitude, the program gives you your grid square and distance from the nearest city.

Two other program innovations are: squint angle window (in addition to the standard footprint), and running the tracking functions in a background program to aim your antennas while you continue with other tasks on the same computer!

Instant Track perfoms best on an AT-class machine with coprocessor and EGA or VGA display, but will work either without the math chip or on a vanilla XT.

At this writing, Instant Track will most likely be available as share-ware with a requested donation of $50 to AMSAT (address on the program). Contact *Project OSCAR, PO Box 1136, Los Altos CA 94023-1136*. for more information.

GGTE MORSE TUTOR

Morse Tutor runs on any MS-DOS computer, with as little as 128K of memory, and easily matches the clock of most users' machines.

The Morse Tutor program offers the user a choice of two methods of Morse code instruction—Standard or Farnsworth. The Farnsworth method allows independent character and word speed settings—Morse learners can set the character speed at the goal speed, which means they don't need to relearn a new sound for the same character as their copy rate picks up.

This program takes you from an introduction of all the letters in the alphabet, the numbers 1-9, 0, punctuation, and pro-words (telegraphy-specific codes), to sending you a QSO built by the program itself!

Morse Tutor replaces your Elmer in two critical areas: It chooses one of billions of possible random QSO combinations to send, making them impossible to predict, and it lets you immediately check copy accuracy.

Morse Tutor retails for $20. Contact *Uncle Wayne's Bookshop,* 73 Magazine, *Forest Rd., Hancock, NH 03449.* 73

ABOVE AND BEYOND

VHF and Above Operation

C.L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake
San Diego, California 92119

PC Board Techniques

This month we'll cover questions about PC board production and methods. While there are several methods that give good results, only two basic methods are outstanding. Proper selection of board materials and the type of traces on the board are all important, especially at UHF and above.

The most common methods use photo sensitive boards, silk screen inks, copied Mylar™ transfers, and direct transfers or rubon's. In choosing one method over another, consider the cost of supplies versus the quantity of boards you wish to make. If you only want to make one or two PC boards, I recommend going with the photo (sensitized) resist method.

Photo Sensitized Boards

This method has several pitfalls, but you can avoid them with careful preparation. The watchword is cleanliness. You can buy the PC board pre-sensitized, or you can sensitize it with spray-on chemicals. Ready-to-go stock is a little pricey, but gives very good results. The problems with this method are improper exposure, poor cleaning of board stock (home sensitizing), and chemicals that have become weak from having been stored too long.

With photo resist, problem boards don't show until after you pull them from the etchant. If traces are mistakenly etched away, you have to junk the board and start again.

John WB6BKR uses the home-spray sensitized PC board technique, and it works very well for him. John made double-sided PC boards by first using a clear notebook cover for the front and rear backing of the PC board artwork. The artwork is placed on the inside of this V-shaped piece of clear plastic film to allow the artwork to come in direct contact with the PC board. This makes a good light seal for exposure, and also allows proper registration when making double-sided PC boards. The inside of the front is the top surface of your double-sided board, and the inside of the rear film is the bottom.

To home-sensitize, spray the photo resist on the cleaned PC board. Apply two or three thin coats, letting the photo resist dry between coats. The finished artwork in its V-shaped envelope allows the PC board to be inserted for exposure to strong ultraviolet or sunlight on each side. The frame to hold this can be a small piece of glass with a solid back to prevent light reaching the other side until you turn the board. Also, the frame holds the artwork in tight contact with the board, preventing light from undercutting the negative.

Simple PC Board Methods

On very simple or prototype PC boards, the cut-and-peel or masking tape works fine. You can cut some films with an X-acto™ knife and transfer the completed pattern to a silk screen for volume production. In the masking tape method the traces are transferred to the tape (paper side) via a piece of carbon paper, and the portions to be removed are cut out with an X-acto knife. The remaining tape serves as the "resist" to the etchant. This is good for only one board.

Silk Screen Method

I favor the silk screen method, which I've been using for the past 10 years or so, mainly because of material costs. The boards I've made were for club or multiple board projects. For quantity production, a $10 quart of ink does about 2000 PC boards. The silk screen material, about $20 per square yard, is polyester (305 threads per inch). The sensitizing film or transfer film can be either cut with a knife or transferred from photo negatives. The film is made by Ulano, 210 E. 86th St., New York, New York 10028, telephone (212) 628–7960. I use the RX-200 and RX-300 photo transfer films. Capillex-25, a newer film, costs about $10 for a piece 24" X 40". (You can handle this film in normal light.) This sheet of film can make patterns for several years.

The inks used in making PC boards are all petroleum based. I use Naz Dar Circuit Black 211, which is excellent in combination with ferric chloride as a etch. You can order it from Naz Dar, Garden Grove, California, telephone (714) 894–7958. I apply the ink with a squeegee, forcing it through the open patterns in the screen onto the copper PC board foil. Note that the artwork transfer films and blockout are all water-based. This distinction makes the screen printing easily reusable. If you wish to keep the screen, clean up the printing inks with paint thinner, and store when dry. If you wish to remove the transfer film, wash it with lukewarm water and it's ready for a new pattern. This makes screen printing very inexpensive.

Boards for Up-Frequency

In making a PC board for VHF/UHF, always use double-sided board. Etch your traces on the bottom of the board, and retain the top copper surface to serve as a common ground. This gives all ground connections a low impedance connection to VHF/UHF circuits. It's common to solder a short piece of copper or brass ribbon, folding the edge to give you a full ground surface around the outside of the board. Solder to both top and bottom. PC board traces at UHF do not like abrupt corners, so trim off the sharp edges to about 45 degrees. The exception to this rule is in stripline techniques. In stripline, the entire trace is made for a set impedance, and trimming would change this impedance.

Drill all connection holes for those connections not requiring grounding. Ream the holes in the the top of the board with a 3/16" to ¼" drill bit to give clearance to the component leads when mounted on top of the board's ground surface. Instead of a drill bit, you might want to use a more professional tool. Vector, 12460 Gladstone Ave., Sylmar, California 91342, makes a $15 pad cutter, Part #138APD, for just this purpose. It centers on the drilled hole (0.040").

Now drill the holes for connections requiring grounding. Do not ream ground holes. These ground holes are soldered on top as well as on the bottom of the board, giving you a shield and low inductance ground connections. This is very important at VHF/UHF. All other connections are soldered only on the trace or bottom side of the board. The alternative would be to use plated through-holes, but that's beyond simple garage operation.

Combine a good photo transfer from negatives from magazine articles or original artwork, and photo the negative to the transfer film. Adhere it to the silk screen, and you're ready to make boards any time you desire. By making your own frames, you can save even more. The frames resemble a picture frame with a deep-cut center on one side. This groove holds the screen material taut with roping similar to that in aluminum screen doors.

PC Board Material

The next most important part of board construction is the board itself. Most high quality PC board material is a fiberglass-epoxy type called G-10. Avoid bargain boards made of paper or similar dielectric types. They tend to pick up processing chemicals and hold moisture. At VHF and higher the abnormalities can cause problems.

G-10 fiberglass-epoxy PC board material is consistent and available in surplus quantities. Check nearby PC board houses, as they might sell scraps. When cut, the edges of this type of board are sharp, due to the fiberglas cloth used to make the dielectric material. Normally this type of board material has a dielectric constant of 5, which you can verify by measuring the capacitance of the sample double-sided board and calculating the constant.

Normally G-10 epoxy PC board material is not used on frequencies above 1300 MHz due to RF loss. Low-loss Teflon™ fiberglass, with a dielectric constant (Esr) from 2.2 to about 2.5, is commonly used. How important is the dielectric constant (Esr)? A higher Esr allows smaller circuitry at VHF and microwave frequencies. The Esr's of some low-loss aluminum and ceramic PC board materials go as high as 10 to 20, making for very small circuitry. Using G-10, I limit my construction to 1.3 GHz, and using Teflon, up to 24 GHz.

Duroid™ is a very fine form of Teflon with excellent dielectric stability due to the board components being cut up to a very fine consistency. This gives a high probability of repeatable circuits in large volume production. Normal woven Teflon may have irregularities, though I haven't had any trouble at 10 GHz with it.

Starter and PC Board Kits

Checking the catalog from Newark Electronics, I found several starter kits for printed circuit board construction, listed below.

You can order them from Newark Electronics, 17802 Irvine Blvd., Los Angeles CA 92680; (714) 669-1641. 6321 North Avondale Ave., Chicago IL (312) 792-8233; and 1001 Virginia Ave, Atlanta GA (404) 761-9902.

1. Standard Manual Resist Kit #00Z748. $9.65 3/ea, 3"x6" PC boards, resist pen, pressure sensitive tape-strips, etch and etching tray.

2. Standard Photo Resist Kit #00Z750. $12.85 3/ea, 3"x6" presensitized boards, cut-and-peel negatives, glass exposure frame/clips, developer etch and tray.

3. Manual Photo Resist Lab Kit #00Z767. $83.20. Makes 3 sq. ft. single- and double-side boards, plain and sensitized boards, artwork for manual or photo resist, exposure frame, photo flood lamp, develop etch solutions and trays.

4. Silk Screen Printing Kit #00Z753. $103.90. Complete materials and equipment to make silk screen printer with 10"x12" frame and 3 production stencils. Factory-made frame with silk, two extra silks, hinges, squeegee, film exposure frame, U/V exposure lamp, black and white inks, thermometer, developing and blockout solutions, and glass tray. Finished printer can make 1000 impressions per day.

The photo resist kit is less expensive, but the number of PC boards you can make is limited to the sensitized board stock in the kit or new purchases. While the silk screen kit is more expensive, you can add common components from a well-stocked hardware store.

"I favor the silk screen method (for etching PC boards)."

Ferric chloride is the most common etch, so whatever method you use, the etch is the same. Many parts houses stock etch in quart containers, but you can obtain it cheaply from some chemical supply houses in larger quantities. The least expensive quantity is a "Carboy," which is about 14 gallons weighing 175 pounds. It costs about $80 with a $15 to $20 dollar deposit on the container.

Another source for your needs is Midland Technologies, 34375 E. Frontage Rd., Bozeman, Montana 59715.

Mail Bag Comments

Steve Noll WA6EJO writes that the Ventura 10 GHz beacon is active from Red Mountain, elevation 2080 feet. Power is 140 mW from a Gunn diode, and the frequency is 10.256 GHz, the 70th harmonic of 146.52 MHz. The antenna is a 17 dB horn vertically polarized with MCW ID. The Ventura club is actively taking off on a club project to construct 10 GHz transceivers.

John WA4WDL liked the home-built dish antenna by N6XQ in the April issue of *73*. He comments that Jack N6XQ is correct as long as each added parabola is perpendicular to and centered on one passing through the origin. In Jack's antenna, each rib is perpendicular to and centered on an imaginary rib passing vertically through the center of the antenna. His symmetrical design and two sideboards accomplish this. It is nice to see even a simple proof or demonstration worked out.

Bob N0DQD in Parker, Colorado, picked up several of the 10 mW 10 GHz transceivers at Dayton and is experimenting with them. He has modulated one with a carbon button mike in parallel with a 10Ω resistor in the DC feed to the Gunn device for AM modulation on a Gunn transmitter. This is more proof that just a few dollars and some experimentation can launch you into microwave operation!

Clint KA7OEI/3 is building a 23cm transceiver. He was trying to obtain a good mixer until he saw my construction article in the October '87 issue of *73* on a home-built 23cm mixer. He's going to include the mixer in his project. Clint is also collecting parts for 10 GHz operation.

I am putting together a list of beacons, and it will soon be available. Let me know if you have any beacon news so I can include it. This list is for any beacon operating from 50 MHz on up.

As always, I welcome your comments and want to hear from you about VHF/UHF/microwave projects and related items. Let me know what you would like to see in this column. Please send an SASE for a prompt reply. 73

Number 26 on your Feeddback card

KEYWORD INDEX

Issue #350

Number 22 on your Feedback card

LETTERS

From the Hamshack

A True Reader

Just a little letter to inform you that your magazine is great! I'm currently obtaining my Novice, and I find your magazine very helpful in learning and understanding amateur radio. I'm not a subscriber, but I can assure you that I purchase your magazine every month via a friend's bookstore. She holds it for me, as my job requires traveling and magazines don't fair too well in my mailbox. Keep up the good work.

Mike Persechino
Columbus MS

Good Bait, No Bite

I just finished reading your June 1989 editorial about getting children interested in amateur radio. Though I have been impressed by most of your editorials, this one misses the mark; specifically because it tends to blame parents, television, the ARRL and the educational system.

We have two children (now adults) who we tried strenuously to interest in ham radio. We did everything you recommended and more. We even made the faculties of our electronics engineering firm available to our children and friends. We encouraged apprenticeship in our business, provided cash, equipment, and most of all, our time. We even offered bonuses for getting a ham ticket and upgrading.

What was the result? My son ran off to California. The parents of an apprentice threatened to sue me for allegedly using an idea which I had seen published years before. Another apprentice quit and tried to switch our customers to another company. And so on.

You're right about training the dog; but he hasn't learned to copy 5 wpm yet! As for the children and their generation, my wife and I don't know that anything more we could have done would've made a difference. What we do know, however, is that when we put away our checkbook—that made a difference!

Anonymous

Boycott Hams in South Africa?

I read a copy of the May issue of *73* and had to check the date. 1989 or was it 1959? It was 1989. I was appalled at the "Problem? What problem?" style with which the items in QRX and 73 International concerning South Africa were written.

Don't you people check the news once in a while? South Africa is one of the worst countries in the world for racism and civil rights violations. I know the ARRL goody-goody/no politics 1950s mentality says that this is no place for such issues, but the fact is that no sane, informed person can justify the policies of South Africa.

So if you do send a report to Radio RSA, tell them that their government sucks. Edit that, and you're gutless. Wanna be like *QST*? If you travel to South Africa, get on 2 meters, strike up a conversation, and after things get friendly, tell them that you're black. See what happens. Tell them that their government sucks. (Of course, that person could be black, but I'm sure that the frequencies are clearly marked there.)

Brian Longwell WB2DSH
Lawrence MA

When the government of a country does not live up to our ideals, should we stereotype all the individuals in that geographic area and sever the lines of communication? Or should we keep in touch so that we can share our viewpoint and support people in South Africa who are working for equality?

Person-to-person communication is what ham radio is all about. Prejudging an individual on the basis of his QTH seems a bit extreme. Besides, racial prejudice isn't restricted to South Africa... Linda KA1UKM

EM Zapping

When I opened the September issue of *73*, I was delighted. Paul Brodeur is an occasional contributor to *The New Yorker*, which I've read for more than forty years. I read his three articles with more than passing interest, having been a ham for more than thirty years. But when I mentioned them on our weekly session of QCWA, they were passed off as "some kooky article." I offered to copy the articles for anyone interested, and drew a blank.

In August, at the L.A. HamCon, my wife, K6YCP, and I attended the two-hour session devoted to the subject of electromagnetic radiation and amateur radio. The speakers were: Dr. Sam Milham, epidemiologist for the State of Washington; Dr. Robert Davis, also an epidemiologist in Washington; Dr. W. Ross Adey K6UI, Associate Chief of Staff for Research at the Loma Linda Veterans' Hospital; Dr. David Rodman KN2M, an ophthalmologist in Buffalo, New York; and Dr. Ivan Shulman WC2S, a cancer surgeon in Los Angeles.

The presentations were first class, with excellent slide illustrations. At the end there were questions and handouts:

1) From *Lancet* issue of 6 April 1985: "Silent Keys: Leukemia Mortality in Amateur Radio Operators," by Samuel Milham, Jr.;

2) American Journal of Epidemiology, vol. 127, no. 1: "Increased Mortality in Amateur Radio Operators Due to Lymphatic and Hematopoietic Malignancies," also by Milham;

3) *American Journal of Epidemiology*, vol. 128, no. 5, November 1988: "Mortality by License Class in Amateur Radio Operators," by Milham.

The Southern California 6 Meter Club taped the session, and offered to dupe it for clubs wishing to send a blank VHS cassette.

I mentioned the subject once again on the QCWA net, and several old geezers replied with "Hogwash!" This leaves me feeling frustrated, as you probably can imagine, when the evidence is readily available.

I think Brodeur's articles, "The Annals of Radiation," should be required reading.

Mac Peirson W6QBW
West Hills CA 91307

A book on my shelf for many years, *Electromagnetic Fields and Life*, by A. Presman, a Russian biophysicist, published by Plenum Press in 1970, is an overview of work done worldwide in frequencies from DC to SHF. Presman has citations going back to 1926! Nothing new here.

I was particularly interested in Brodeur's comments regarding ELF modulation of 2 meter RF emissions and the effects on the brain. Another fellow, Robert A. Monroe, author of *Journeys Out of the Body*, has developed and patented a technique for impressing 5–10 Hz waves on the brain, using an audio modulation technique he calls "Hemi-Sync." His purpose is basically to set up a mental environment favorable to such activities as out-of-the-body travels, stress reduction, skills improvement, and learning enhancement. The point is that we have clear evidence that ELF signals not only have biochemical effects, but that they also modify our mental/behavioral states.

Since we've been subject to these fields for several generations, there is considerable reason to suspect that many of the things we bitch about are the result of this exposure. I refer specifically to the apparent decline in our mental faculties, as evidenced by lower SAT scores, rotten school graduates, and the general apathy and malaise we see about us.

Why do we old farts seem to be the only ones who have any fire anymore? Because the *rate* of damage is increasing. When we were kids, residential load centers were typically rated at 40–60 amps or less. In the '50s and '60s, 100 amp load centers were specified, and now they're up to 200 amps.

You'll remember the oft-stated theory about the decline and fall of the Roman Empire being due to the use of lead water piping and the consequent brain damage over an extended period. Isn't it an interesting parallel?

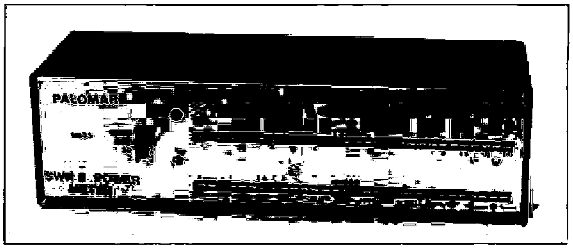
The California Public Utilities Commission has come up with a 500-page draft report on the question, and I've ordered a copy. Your call for ham-designed Gaussmeters is a good idea. After all, we hams are the certified technical experts in our communities (most of us are just certifiable, I think). Where else can the public go for honest, unbiased information?

Tom R. Rice WB6BYH
Livermore CA 94551

Whoa, Tom, re-read my June editorial, "Oh, Darn, My Kid's Gone Bad," before giving 60 Hz magnetic fields credit for lousing up our kids. I suspect we parents are doing that through massive neglect, with no help needed from the power companies...
Wayne

NEW PRODUCTS

Compiled by Linda Reneau KA1UKM

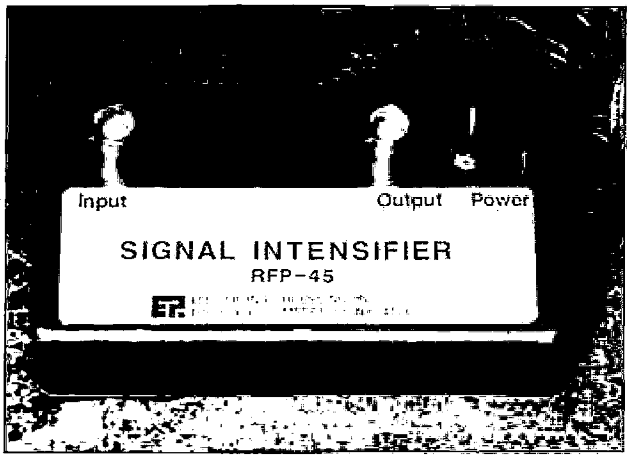


PRODUCT OF THE MONTH

PALOMAR ENGINEERS SWR & POWER METER

Palomar Engineers announces a new deluxe SWR and Power Meter, Model M-835, which gives accurate readings continuously, even during CW or SSB operation. It has four power ranges: 2, 20, 200, and 2000 watts. Both power and SWR are displayed continuously on 6" light bars with 3% resolution. The M-835 operates from 1.8 to 30 MHz, and requires 12V DC.

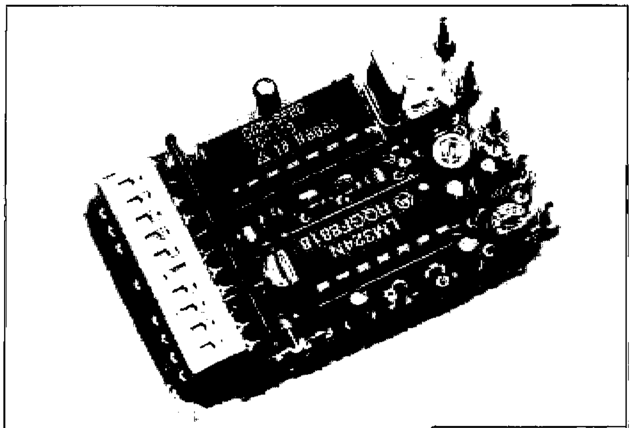
The meter sells for $190. The AC adapter is $15. Send for a free catalog from *Palomar Engineers, PO Box 455, Escondido CA 92025. Tel. (619) 747-3343.* Or circle Reader Service No. 201.



ELECTRON PROCESSING, INC.

Electron Processing announces the first battery-powered receiver preamplifier, the RFP-45, easily tailored to almost any installation. Housed in cast aluminum 2.5"x4.5"x1.5" with improved lightning/static protection, the RFP-45 provides 15 dB of gain from 1 MHz–1300 MHz, with a low 2.8 dB noise figure. This signal intensifier, powered by two 9V batteries, covers MF to UHF frequencies. The RFP-45 is perfect for portable use when AC power is not available.

The RFP-45 is $100, with quantity discounts. The price includes your choice of BNC, SO-239/UHF, or F connectors. *Electron Processing, Inc., PO Box 708, Medford NY 11763. Sales Department, (516) 764-9798.* Or circle Reader Service No. 203.



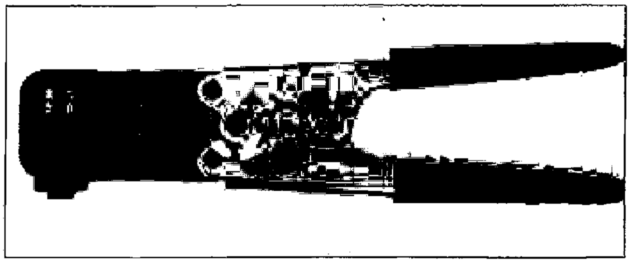
MODEL PE-2P

COMMUNICATIONS SPECIALISTS, INC.

Communications Specialists announces their new PE-2P DIP switch programmable Two-tone Sequential Encoder, designed for mounting inside a radio. It lets the operator send a single two-tone sequential paging call. With standard 1–3 second timing, the PE-2P is compatible with Communications Specialists SD-1000 Two-tone Decoder and other systems, such as the Motorola Quick-Call II, 1+1, and GE Type 99. You can change the timing to match other two-tone formats.

Tones A and B are DIP switch programmed from a 32-tone memory base specified when ordering. Over 1000 combinations are possible from a single PE-2P. With added circuitry, you can wire the PE-2P for multiple calls. The PE-2P, powered by +10–16V DC, measures 1.25"x2.0"x0.4". A momentary ground activates the selected call. A 150 mA output keys PTT.

Price, $55. *Communications Specialists, Inc., 426 West Taft Avenue, Orange CA 92665-4296. Tel. (800) 854-0547 or (714) 998-3021. FAX (714) 974-3420.* Or circle Reader Service No. 202.



NEMAL ELECTRONICS INTERNATIONAL, INC.

Nemal Electronics International presents a new ratchet crimping tool for use in the communications and computer fields. The tool offers full cycle ratchet operation with machined dies for precision crimping and long service life. It features a pin holder and wire locator for easy operation. Part number CT2320 accomodates wire sizes from 20 to 30 gauge.

Price, $95. *Nemal Electronics International, Inc., 12240 NE 14th Avenue, North Miami FL 33161. Tel. (305) 899-0900. FAX (305) 895-8178.* Or circle Reader Service No. 204.

ADVANCED ELECTRONIC APPLICATIONS, INC.

AEA announces MACKRATT with FAX, a computer program for the Apple Macintosh, to enhance PK-232 use. MACKRATT, running the PK-232 in host mode, makes it fast and easy to use all the powerful features of the PK-232. It provides windows for entering text, displaying data and file transfers, and logging transmissions. Ten macro keys simplify and speed data entry. Send RTTY, AMTOR, and CW a character at a time. Runs under MultiFinder. You can send FAX images to the printer without changing cables.

MACKRATT with FAX works with the Macintosh 512K, 512e, Plus, SE, and Mac II. Price, $60. *Advanced Electronic Applications, Inc., PO Box C-2160, Lynnwood WA 98036. Tel. (206) 775-7373.* Or circle Reader Service No. 207.

Number 24 on your Feedback card

HAMSATS

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
14714 Knightsway Drive
Houston TX 77083

DX from the Sky

Working DX via satellite is inevitable if you make any contacts at all via AMSAT-OSCAR-13. Pileups are few, even on the "rare" ones, and conversations with foreign stations are more relaxed than those on HF.

Working 100 countries via satellite, however, is not easy. Two factors not encountered on the low bands work together to make SATELLITE-DXCC a real challenge.

The specialized equipment for transmitting on 70 cm and good reception on 2 meters for A-O-13 Mode B operation is not common in many poorer, third-world countries. The technology for operation on the shortwave bands is quite simple and inexpensive in comparison. A dipole antenna and an old solid state transceiver with a battery are all you need to get a remote location on the air.

The other factor is interest. Working western Europe and Japan via A-O-13 is as easy as working New York and California. Interest is high, equipment is available, and operators are plentiful.

Sometimes only a few operators with a keen interest in the hamsats will provide all of the contacts for an exotic location. Operators like Jon OY9JD, Jean-Louis TR8JLD, and Ron YJ8RG have helped many DX chasers get a new one.

When a DXpedition takes to the airwaves, the satellite operation is usually secondary or nonexistent. It seems that when one does provide an OSCAR position, a well-known satellite enthusiast is involved. Examples include Pascal HB9RHV in Liechtenstein, Beni HC1BI in the Galapagos, and Pedro CE3BFZ on Robinson Crusoe Island in the Juan Fernandez group. We greatly appreciate their efforts and the efforts of others like them.

Photo A. Satellite antennas used at 4J1FS in late May for the DXpedition to Malyj Vysotskij (M-V) Island. (K7JA photo.)

Malyj Vysotskij

In late May, 4J1FS showed up on A-O-13. The previous expedition to "M-V" Island in mid-1988 was well-documented in a feature article in the June 1989 issue of *QST*, but the earlier group did not make any satellite contacts. This time, with only a few days' notice and a "FAXed" visa, Chip Margelli K7JA, Yaesu USA Vice-President of Marketing, came along. Chip brought an impressive array of Yaesu HF and VHF equipment, including an FT-736R for satellite operation.

M-V Island is located near the south end of the Saimaa Canal in Soviet territory near Finland. The DXpedition team was Finnish, Soviet, and American, with Chip of Southern California. The Soviet Radio Sport Federation and the Finnish Amateur Radio League sponsored the event.

While participating in the CQ WPX contest, the multi-national group made tens of thousands of contacts on HF. Several hundred contacts were also made via A-O-13. The FT-736R, rotors, and other gear had made the trip to the politically remote location intact. Chip's signal on Modes B and J (2 meters up and 70 cm down) was excellent. Anyone who wanted to catch the new one via satellite had only to call. There was even time for some casual conversation with many enthusiastic operators around the world and especially with his wife Janet WA7WMB back in Anaheim.

Photo A shows the impressive antenna array for the satellite activity. Although the multi-element yagi was horizontally polarized, the spin modulation was only pronounced when satellite pointing angles were not favorable.

Boris UW3AX (QSL manager for *Mir* space station contacts) got a firsthand opportunity to experience full-duplex high-orbit satellite activity with spin modulation during a session of A-O-13 activity. Wearing headphones, listening to the downlink with roundtrip time delay, and speaking a foreign language with signals rapidly fading in and out can be quite a challenge. Try it sometime!

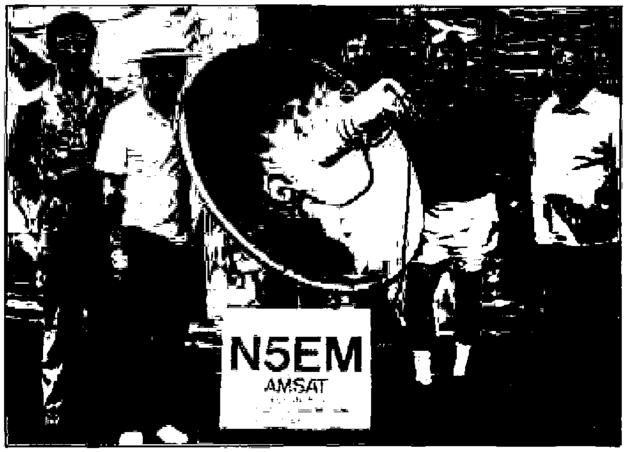


Photo B. The Mode L uplink antenna and some of the crew at the N5EM Field Day station. From L to R: WA5ZIB, N5LKJ, WB5HLZ, N5EM and N5HQM.

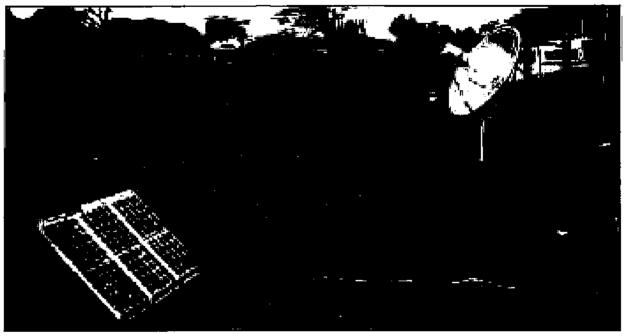


Photo C. Battery power with solar charging and Mode L operation with a four-foot dish at the N5EM Field Day site near Galveston, Texas. (N5LKJ photo.)

Field Day Operations

The description of our Field Day activity from South Texas with Mode L (23 cm up and 70 cm down) in the August "Hamsats" resulted in photo requests from several satellite chasers contemplating similar activities from portable locations. A few stations also operated Mode L on Field Day, but with yagis or helix uplink antennas. The simple four-foot dish with coffee-can feed provided our group with remarkable uplink signals using only 35 watts of microwave energy.

The feedline, pointed by hand, was kept short (Belden 9913). After aiming the dish in the same direction as the downlink crossed yagi, they made minor adjustments by monitoring a transmitted carrier from the dish through the satellite on the downlink receiver. At the highest S-meter reading, they secured the dish fast with elastic cords and vice-grip pliers. No further adjustments were required during the 90-minute Mode L period.

Many groups throughout the country noted good conditions and record numbers of contacts via A-O-13 and RS-10. With several new satellites scheduled for launch during the latter part of this year and early in 1990, Field Day next June could be more hectic and exciting than HF.

AMSAT-NA Annual Meeting

The 1989 AMSAT Space Symposium and Annual Meeting will be held in Des Moines, Iowa this year. Hosted by the Central Iowa Technical Society (CITS) and celebrating the 20th anniversary of the incorporation of AMSAT, the event is scheduled for November 3rd through the 6th. The committee in charge of organization has arranged for a full weekend of AMSAT activities with low attendee cost as a primary objective.

There will be informal gatherings, presentations of technical papers, a banquet following the annual meeting, and a Board of Directors meeting extending into Monday, November 6. The annual gathering was originally scheduled later in November, but possible conflicts with the launch of the Microsats required a change in plans.

The primary hotel is the Hampton Inn, 5001 Fleur Drive, Des Moines, Iowa 50321. Call 1-800-HAMPTON to make reservations. AMSAT reserved the entire hotel and secured excellent rates for those mentioning the RAS GROUP when making reservations. The room rates include transportation to and from the Des Moines airport (a five-minute drive), complementary breakfast, free local calls with in-room movies and plenty of free parking.

Seminars, Saturday lunch, the evening banquet, the annual meeting and the first Board of Directors session will be held in the executive conference facilities of the Meredith Corporation at 1716 Locust Street in Des Moines. Chartered bus and the CITS transportation committee will provide transportation between the Hampton Inn and the Meredith facilities (a ten-minute drive).

This year, seminars will be presented in a single-track schedule. Attendees will not have to miss a thing. Informal sessions of the field organization and command station development program will be held during the wee hours in the Hampton Inn hospitality suite.

"When a DXpedition takes to the airwaves, the satellite operation is usually secondary or nonexistent."

Door prizes are always abundant at the AMSAT Annual gatherings, and the subject material of the presentations is exceptional. The $20 registration fee includes a copy of the symposium proceedings. To get more details and an official registration form, contact: Ralph Wallio W0RPK, CITS Chairman for AMSAT '89, 1250 Highway G24, Indianola IA 50125. Be sure to send Ralph a self-addressed stamped envelope. I'll see you in Des Moines! 73

Continued from page 8
and homeless problem. This would put hundreds of thousands of bureaucrats out of work, cut our unemployment rate substantially and make it possible to reduce taxes. It hasn't a prayer.

Drugs

Ditto my fiendish plan for solving the drug situation. This would quickly cut the American crime rate about 75%, putting policemen and lawyers in unimaginable numbers out of work. It would virtually destroy organized crime. It would wreak havoc with Colombia, Peru, Panama, many Caribbean countries and devastate South Florida. It would force black kids to reconsider school as a career path. It would also cut the heck out of donations to Congress. Let's not upset the boat with any new approaches to drugs. Let's send troops to Colombia. Let's continue to say no-no to our people who are anxious to louse up their lives with drugs. And let's make sure there's so much money to be made that we have an unending source of criminals to feed our "justice" system. It's better to spend $35,000 a year keeping someone in prison than to give him $25,000 to do nothing except keep out of trouble, right? No, I'm not suggesting that as a solution to anything—it's just to show how ridiculously we often spend our tax money.

As a five year goal I've decided to see what I can do about the music industry. It's a mess. Six international megacorporations have managed to organize a cartel which has 96% of all music (record) sales. That leaves about 10,000 independent record companies (indies) which are splitting the remaining 4%. That stinks.

How can I fight these multi-billion dollar international companies? By getting the thousands of indies to cooperate and fight together. So I've formed a group of about twenty new companies which will attack the cartel problem on every side. Each will get the indies to cooperate in some specific area. One will help get indies more airplay on the radio. Another will coordinate their PR efforts. Another will get them more coverage in newspapers. Another sets up a mail order company to handle hard-to-find CDs and cassettes. Another will act as a completely new type of distributor to get indie music into your local record stores.

If I see any clear signs that amateurs are at all serious about wanting to save the hobby or that the ham industry is willing to cooperate for this goal, I'll be delighted to help in every way I can. In the meanwhile I'm making notes for a book on how amateur radio was lost, and what this loss means to America's future.

The Save 220 March

Unless you've been hiding under a rock, you're aware of the recent "Great March to Save 220." With less than 150 hams bothering to participate, the term "great" may be an exaggeration. The "Great March" had two results—first it showed that "most hams aren't alarmed if their bands go away. It's too much trouble to care." That's a quote from Westlink, by the way. Secondly, the "March" did have the intended effect of further alienating the FCC, the group which has the power of life and death over amateur radio. Just what we needed, a further angered FCC. And what great timing, just as the new commissioners are being sworn in! The "March" was a disaster in conception as well as execution. Great work! And no, the ARRL did not think up this debacle.

What should we do? I suggest you take a good look at the list of firms and clubs who have supported the NIAC approach and get after those who have so far refused to invest $100 toward protecting our future. Once the new Bush appointed commissioners are in place, we need to have an industry team meet with them and bring them up to date on the critical importance of amateur radio to our country, both as a source of engineers and technicians, and as a resource in time of emergency. Check the *73* ad index for NIAC supporting firms.

Demonstrating in front of FCC offices and suing the FCC aren't likely to help preserve our bands. Talking reason will generally beat the heck out of threats and punishment. There are some good positive reasons why the FCC should be working with us toward rebuilding our growth, but without any dialog everyone will likely be a loser.

I've had enormous success in the past with making appointments with the commissioners, flying down for the day and sitting down with them for a couple hours. I've always found them hungry for information and interested in helping, once they understood what's involved.

With all due respect to the League—and I can understand their anger and frustration over what's happened—their approach of confrontation with the group which has the power to eliminate our hobby, seems ill-considered. What we need is diplomacy, not an expensive and winless war. Yes, there I go, bad-mouthing the ARRL again. And right after they sent me a beautiful 50-year membership plaque, too! What an ingrate! Let me put it this way, do you think the League is going the right route to sue the FCC instead of trying to use diplomacy? Leave my opinions out of this entirely. Forget 'em. What do *you* think?

Hey, I've been supportive of the ARRL no-code plan, haven't I? Well, yes, I have hinted that their plan falls about 99% short of the target, but at least they're shooting in the right direction, even if they're using BBs when we need a Stinger missile.

The 14,313 Mess

Speaking of missiles, we seem to need some help on 14,313 kHz. I've been trying to find out what's going on there, but the reports are confusing. I gather there are several nets around the world which time share the channel. But for some time they've been complaining about getting jammed by KV4FZ, who seems to have earned international condemnation for his efforts. Pity, cuz Herb used to be one of the good guys, but that was a long time ago.

Even worse, Glen Baxter K1MAN, a chap I cannot describe easily in a family magazine, apparently not satisfied with the enemies he's made on 14,275, has moved into the 313 mess. Glen and his IARN may be doing some good now and then, but my experience with what appears to be an all-mouth-no-ears personality may have blinded me. I get the impression that he'd like to be a ham version of Yassir Arafat.

I'll put my money on Ed Ricca K4PT, who's been running the International Phone Net on that frequency for years. Ed's an old friend from Brooklyn, back in late 1945, right after WWII. I had many a midnight coffee and danish with Ed and his wife Jeannette at the W2OCL shack in the late '40s.

I've so far resisted putting my kilowatt on 14,275, starting a few minutes before K1MAN, and broadcasting endless tapes of stuff of interest to amateurs—a sort of *73 Magazine of the Air*. Let's see, we could run my last 38 years of editorials, all read in an enthusiastic way by me. You certainly wouldn't want to miss out on a list of all known hamfests for the next 30 days, right? And perhaps a list of the articles appearing currently in all of the ham magazines. You won't want to miss any DXpedition news, naturally. Then we could get into commentary tapes from listeners with their views on my editorials. All this is well within the FCC guidelines for legitimate broadcasting.

But what if Glen turns on his rig without listening and interferes with my 275 transmissions? Mercy! Well, I certainly don't want any hams around the world to miss my incredibly important information, so the obvious answer is to have someone at a distance check the channel and, should unintentional interference come from K1MAN, because he "forgot" to check the channel before broadcasting, develop, I could fire up a second kilowatt on a nearby channel. I've got several kilowatt rigs I could get on line here, each with a nice sloper dipole for relatively non-directional coverage. I think I can get more kilowatts on the air than Glen.

Check out 14,275 and 14,313 and let me know what you think I should do. Will I serve you best by going on a DXpedition and skin diving trip to the Caribbean or by zapping a few 20m frequencies with endless ham-oriented news broadcasts? Or would you rather have me send 24 hour-a-day RTTY information bulletins on 275? Please advise.

Yes, I know there'll be a few drug-crazed or CW brain-damaged old hams who will wonder if I'm really serious. Hey, they don't give intelligence tests with the ham exams, right?

Fast Driving And DXing

Some readers have been fussing with me for driving fast and thus needing a radar detector. After all, they say, if you drive slower you'll still get there, it'll just take a few minutes longer. And besides, everyone knows that speed kills, right?

Rather than buying a knee-jerk agreement with all that, I prefer to approach the problem with reason. I've put over 120,000 miles on my Toyota van in the last six years—that's 20,000 miles a year. Okay, if I stay within the

20m Fire Breaks Out

The FCC reported that a fire of suspicious origin broke out on 14,219 kHz on September 27th at 0150Z. The fire was first thought to have been caused by too many California kilowatts in a pileup calling (or trying to drown out) a DXpedition on that channel.

An FCC spokesman said that a careful examination of what was left of the frequency gave clear indications that this was not spontaneous combustion, but a deliberately set fire—possibly intended to prevent further communications with a DXpedition. Two well-known California DXers are being investigated. Both had made one original and two safety contacts with the DXpedition, so the motive may have been an attempt to prevent other DXers from contacting this new country.

The fire started in the Los Angeles area and quickly spread to Texas and several Pacific Islands. The fire, which started on 14,219 kHz, also damaged several adjacent channels. Only quick action by several volunteer DX groups prevented the gutting of the entire 20m band.

Bill Pasternak WA6ITF has already spearheaded a salvage effort asking for donations from DX groups to help repair the extensive damage done. Money is desperately needed, and fast. If the weakened superstructure on 14,219 isn't replaced quickly, it's possible that the entire band could collapse. All it would take at this time would be an ill-advised ARRL contest or the cumulative impact of several simultaneous DXpeditions. This could leave us with nothing but a burnt out hole on our dials.

Amateurs are asked by the FCC to avoid going within 10 kHz of 14,219 for the foreseeable future so their inspectors can check for clues to the perpetrator. This will also help keep the frequency clear for emergency repairs.

Two or three Extra Class DXers have been arrested for scavenging through the rubble, apparently looking for partially burned Hertz which they might steal. With even old, badly worn Hertz having a market price in the tens of thousands of dollars, it was difficult to keep the scavengers at bay.

Westlink reported a 73-point drop in 20m stock as a result of the fire. This brought 20m stock below that of the 2m band for the first time since the sunspots went above 50.

The ARRL, possibly over-reacting, issued a bulletin asking their Official Observers to police the band, requesting all amateurs to avoid using 20m until the FCC feels it's safe. The RSGB announced they would cooperate with the ARRL. The REF said French amateurs would continue to use 20m, that a fire in the US was of no concern to them. After all, few French amateurs bother to work US amateurs anyway.

Reports that the PLO had claimed responsibility for setting the fire have been discounted by the CIA.

White House Chief of Staff, John Sununu, assured reporters that President Bush is deeply concerned and extends his condolences to the families of any amateurs hurt in the disaster.

speed limit around Peterborough, where I do most of my driving, I'll maybe be able, on better days, to average 30 mph. That's 660 hours a year on the road.

If I just pep that up to a 40 mph average it'll take me 500 hours a year—a saving of 160 hours. That's four work weeks! In other words, by pushing a bit I'm able to get in an extra month of work more than my dawdling neighbors. That isn't the only way I save time, but people are always asking how I can get so much done compared to most other people. By not wasting as much time, that's how.

If I push the van a bit harder I can average 50 mph, cutting my driving down to 400 hours a year - saving another hundred hours—two and half more weeks of work. So I try to average about 50—and succeed pretty well, thanks to my radar detector.

Now how about the danger of driving fast? As I recall, over 85% of the fatal accidents happen under 40 mph. Thus, by never driving under 40 mph I'm able to cut my chances of having a fatal accident by 85%. I like those odds—like 'em a lot. Since 65% of the accidents involve alcohol, and not only do I not drink, thereby cutting out at least half of that kind of possible accident, I drive very defensively, making it difficult for a drunk to hit me, even on my side of the road. Several have tried.

Driving faster also has the benefit of exposing one to the dangers from other drivers for a shorter time. Let's not reduce that to absurdity by going through intersections at 100 mph and hoping for the best.

I save time many other ways. I watch more TV than you may think I do, cutting the time by taping everything. Thus I speed through the program openings, commercials and closings, getting me down to around 45 minutes per hour program.

Shaving in the shower saves a few minutes a day, plus I get a far more comfortable shave. A few minutes a day—big deal, right? If I save just seven minutes a day by changing small routines like that, I've got an extra 40 hours a year - an extra week for work or even a ski trip that you don't have.

By having an office at home where I do most of my writing, I save on commuting time. Oh, I have to drive to my publishing offices a couple times a day—a six-minute trip. In good weather I do it on my Yamaha scooter, which is a bit faster than the van. In the van I get double use of the time by reviewing new CD releases while I drive.

How much time could you save by really paying attention to it? If you aren't by nature a fast driver you probably shouldn't save time by driving fast. But there are plenty of ways you can save time when you give it thought. If this just means being able to watch another sitcom a day, why bother? But if it means being able to start a small business at home which could eventually make you independent. . .? All it takes is an idea and the guts to give it a try. So let's not hear the old saw that you don't have time. . . okay? The least you can do is read a few more books and magazines, thus adding to your work skills and making you a more interesting person to talk with on the air.

If you have enough money to buy all the ham gear your heart desires, then save time so you can get a signal on through a ham satellite—now there's a real challenge! Or how about setting up a 220 repeater cross-banded to 75 meters so Novices will be able to join in the round tables?

But, Is It Legal?

A recent letter said that many hams who apparently live very isolated lives are unaware that it is completely legal for Novices (or any other class licensee) to be repeated on the low bands and make cross-band contacts. Preserve us from the Nervous Nellies who wring their hands in anguish. . . "Golly, do you really think it's legal? Maybe we better get a letter from the FCC saying it's legal before we do that."

For the tenth from last time, if you don't know the ham rules yet, then please read 'em so you will. The basic law of survival with the FCC is simple: If it isn't prohibited, it's legal. That means if you aren't sure about it, go ahead and do it until you get an official complaint from a monitoring station—which is most unlikely because the FCC doesn't bother monitoring the ham bands much these days. Perhaps it's too depressing. If you do manage to get a citation, you can apologize—if they can cite an actual rule against what you've been doing. The positively worst thing you can do is ask first. You certainly should know enough about bureaucrats by now to know that they're never going to risk their careers by making decisions which could ever be challenged. So when you ask, the answer will always be the same: no. Then something which might never have been questioned because it wasn't prohibited is now illegal. Don't ask. And if you have a friend who insists on asking, convince him to do it your way. Use force, if necessary. Whatever force it takes.

If you do take this time thing seriously and free up previously wasted time, may I suggest for the umpteenth time your finding a youngster to Elmer? I can't help but think of Bill Welch W6DDB and his wife Marie W6JEP, who have brought thousands of Novices to our hobby. As far as I know, no one even comes near Bill and Marie in developing and licensing Novices. But it's worth trying to beat them.

The new Novice voice privileges seem to be making a difference, so let's take advantage of this and build momentum. If you have a radio club in your area—and most of you do—it's time to start going to meetings again and get the club interested in bringing in Novices and setting up Novice classes.

If the club repeater doesn't have an input in what's left of the Novice 220 band, get it set up so they can work each other on 220 and also get through to the 2m repeater. A cross-band system to the lower bands is more difficult, but will be great fun—and not just for the Novices.

Back before the FCC made it illegal, my WR1AAB repeater cross-banded to 10m and made it so hundreds of New England Techs were able to work all around the world. When the FCC outlawed it, I organized an FCC oral hearing (1974), bringing in repeater spokesmen from all around the country to testify. This hearing resulted in the deregulation of amateur radio, the largest change in FCC regulations ever—and cross-banding was once more legal. This triggered the whole FCC deregulation movement.

If you have some club members who don't want Novices bothering them, see what you can do to bring the curmudgeons around. It's probably too late to change some. Many people are so used to being negative and sour that they are frozen in that mode. They aren't much fun at club meetings, at home, to work with, or on the air. Happy people are not only more fun, they live longer and are much more successful.

Much of life calls for salesmanship—at home it makes life simpler, at work, whether you're on the line with customers or managing people, it's salesmanship that wins. That's the essence of "How To Win Friends," a great book you should get your kids to read, even if it's about 50 years old now.

Salesmanship is finding a way to get people to want to do what you'd like them to. It's the only way you can train animals successfully, and it works just as well with kids and club members. I've got three retired racing greyhounds which are fun to work with. You can't force a greyhound to do anything—they just look martyred and lay there. But they'll do anything you want once you've convinced them it's just what they wanted to do. How do *you* go about getting people to do things? Your wife? Your kids? Your employees? Your supervisors?

On the air are you fun to talk with or are you sarcastic and easily angered? Do you tend to be a "no space cadets" op, a la the infamous W2OY? Or perhaps an op who gets pleasure out of jamming medical emergency nets like W2BIB did? A sanctimonious repeater control op can precipitate endless jamming and kerchunking in retribution, making life miserable for everyone.

No, you don't have to gush love over the air. Just be nice, even when it's hard to do. When you're frustrated, it's difficult to remember to be nice. It's awful to hear a rare DX station talking endlessly with someone and not standing by so you can break in. You know the band is going to change and you're going to lose out. Talk about frustration!

Or you chance upon a list operation working one you desperately need. A half hour fighting a pileup to get through to a DX station is bad for you, for the others in the pileup and miserable for the DX op. It's a lose-lose-lose situation until you crush or outsmart the others and get through and make your silly ten second contact. The eventual contact is never going to bring back the hours you've shortened your life by being frustrated and angry.

Medical science (all too often an oxymoron) agrees that negative emotions suppress the immune system, opening you to whatever bug or virus happens to be present. A study by Dwight Bulkley showed that every illness can be traced back to a drop in the immune system's power, usually triggered about 33 hours earlier by an emotional trauma. Oddly enough, he also found that many accidents could similarly be traced to a delayed reaction to earlier traumas. That fender-bender, stubbed toe or cut finger can be a reaction to your anger over a net jammer a day and a half ago.

There's much to be said for learning to avoid things which upset you. I wonder, if this ever became widely known, would it end DXing and contests?

One more thing, while we're discussing ham frustrations. An old time ham (what else is there?) was concerned about our encouraging so many new Novices. Won't that make our already full bands even worse? Obviously he hasn't been reading my editorials. No, if we can get a few more on 20m, perhaps it'll get more old timers in a frame of mind to encourage new communications modes. I explained how we could easily develop voice systems which would permit a thousand or more times as many contacts in the same bands, with less interference. The technology is there, we just haven't bothered to develop it. Perhaps we're waiting for the Japanese to do it for us.

Though most of the Spark-Forever hams have won their Silent Key certificates, we're still hearing an occasional surviving AM-Forever. When we get some new modes going, we'll start hearing SSB-Forever and FM-Forever. Sigh. The upside is they'll shorten their lives and thus not annoy us for long. 73

UPDATES

Number 33 on your Feedback card

UNIDEN HR2510 POWER MOD UPDATE

Due to a technical inaccuracy in my original test set-up, the PEP power levels on page 48 of Sept. "*73 Amateur Radio*" were erroneous. After revamping the test bench equipment, and testing the new wattmeter against a Bird 43, the findings are as follows: in modified radios, 2–3 watts carrier, and 10–12 watts PEP average increase over the stock peaked-out radios. Therefore, the original goal was reached, i.e. more power with better audio, and less stress in the RF output section.

I sincerely apologize to everyone who may have been inconvenienced by the original results printed. With regards to all, M.T. Stacey, KC4HGH.

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

RTTYers Speak Out

The readers of this column are a vocal lot! I was both overwhelmed and gratified by the response to the survey I published here a few months back, and I didn't anticipate so many responses.

To begin with, and it's no big surprise, 94% of you are active on RTTY, with the rest interested in getting on in the near future. Only about 30% of you are using mechanical teleprinters, however, with the rest describing various computer configurations. There were no responses from those who were using a dedicated electronic RTTY terminal.

RTTY Systems, Software, and Bands

Among mechanical teleprinters, several of you are using Model 28-ASR machines, and others are using Models 28-KSR, 28-RO, 32-KSR, and 35-ASR. Isn't anybody using a Model 15 any more?

Computers used for RTTY were even more diverse. While Commodore C-64s lead by a few percentage points, there are plenty of PC-XT and PC-AT clones, Tandy 1000s, TRS-80 Models I and III, Apples, Amigas, CoCo 2s and 3s, and even an SSB Chieftain.

With all these systems, it's no shock that the number of programs is even more varied. Some of them, such as the AEA or Microlog programs, are well-advertised, commercial programs. But others, such as YAPP, Super RATT, Mickeyterm, RTTY 1-1, and homebrew OS/9 terminal programs, keep many of you on the air.

As to bands of operation, you are really spread out, with 78% on 20 meters, 64% on 10, 50% on 15 meters, 35% on 80 meters, 35% on 2 meters, 28% on 40 meters, and about 7% on 12 and 18 meters. Of course, this adds up to much more than 100%, as most of you operate more than one band.

Coming Attractions

I asked what you would like to see in RTTY Loop, and the answers, again, were spread all across the spectrum. Leaders were requests for information on AMTOR, and more construction and/or modification projects. We have had some material on AMTOR, and the several construction projects featured recently have just been the tip of the iceberg.

Other topics you would like to see include: SWL reception and bit inversion decoding, packet operation, weak signal techniques, details on older machines (this in spite of the apparent dearth of such machines in use), the history of radioteletype, getting started in RTTY, operating techniques, mailbox access, and software sources.

Some of you commented on the difficulties folks are having putting older equipment, like mechanical teleprinters no one is using, with some of the terminal units, such as Flesher or HAL. Sources of wiring and interconnection information on these units are few. While we have covered some of this in the past, I don't know whether I have addressed every possibility. Check back issues of RTTY Loop, either in the library or by perusing the RTTY Loop Index, to see if the problem was described. If so, check that issue; if not, drop me a note with your specific problem.

Make Docs Simpler

Over the past several years we have seen an influx of manufacturers targeting the RTTY market. The comments and complaints I received concerned the quality of documentation supplied with otherwise excellent hardware. It's now relatively easy for newcomers to ham radio to access many digital modes using inexpensive interfaces. The documentation for many of these devices, however, doesn't target entry-level users.

The manufacturers should address this problem by packing some elementary and background material along with the sophisticated literature that comes in these super-boxes. Even I am befuddled by some of these manuals sometimes! Look for entry-level info on the setup and use of these TNCs and data controllers in future columns.

Speaking of befuddlement, another of you elaborated on the confusion on the bands between the 60 speed and 100 speed crowds. This person felt that the biggest pain in the neck on RTTY today is having to constantly switch speeds just to see what is happening, and he believes that we should set 100 speed as the standard because of the many computerized RTTYers out there.

Setting a standard is an excellent idea. On the other hand, however, if we set a 100 speed standard, it would shut out maybe a third of the hams presently on RTTY and make a great deal of inexpensive equipment obsolete. Such equipment often represents the only viable way for a neophyte to approach RTTY. Let's hear from you about this!

Another comment concerned quite a few Commodore C-64 users who are using one of the newer multimode terminal units, and are generally dissatisfied with the terminal program they are using. Jack Skubick K8JS suggests using a public domain program called THIRDTERM. This menu-driven program is said to have logical keystroking, support for most printers, a large capture text buffer, and professional operation and screen appearance. He is willing to send the program to any user who sends him the princely sum of $3. Address it to Jack at 791 106 Ave., Naples, Florida 33963, and tell him you are interested in THIRDTERM, as described in this month's RTTY Loop.

One final note from the pile. It appears that Amiga users are on the rise, with Amiga Users' Nets on 10 and 75 meters, as well as some on 20 meter AMTOR.

Venerable Mode

One of the reasons I published this survey was to get a sense of just how active the RTTY segment of amateur radio currently is. As a facet of the hobby which has its roots back some forty years or more, RTTY predates SSB and FM on a practical level. Only CW is an older popular mode. RTTY shows its age well, continuing to provide both the newcomer and old timer with a unique, fascinating mode of communication for practical service, such as passing messages, and strange entertainment with RTTY pictures and bell songs. RTTY is also a good introduction to the wonderful world of digital communications.

I hear you, and will take the cue to cover all this, and more, in the months ahead. As always, feel free to drop me a note at the above address, or send electronic mail on CompuServe (ppn 75036,2501) or Delphi (username MARCWA3AJR). A self-addressed, stamped envelope will get you an index to past editions of RTTY Loop. 73

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

As we come closer and closer to the European Economic Community and the development of a more open economic system, what will happen to prices of ham radio related equipment? By comparing the present prices of ham equipment and other consumer goods (after conversion to the Yankee dollar) in the European area, and like items in the USA, we can generalize that the European-sold goods are one and one-half to two times (or maybe even more) more expensive.

It also appears that we are becoming more appliance-operator oriented rather than home-brew oriented. With the high cost of buying the newest manufactured ham goods, are we shooting ourselves in the foot? Are our attempts to increase the numbers of young hams being hurt by the high cost of equipment?

For those of you closest to that market, please keep us informed on your observations of the "new economy" as it develops.

Roundup

Australia. From *Amateur Radio* (Australia) via Ken Gott VK3AJU, Federal Awards Manager: "Are the glasnost' and perestroika policies of Soviet leader Mikhail Gorbachov having an impact on amateur radio? I think perhaps they are."

Ken reports receiving his R6K award a couple of weeks ago. Is that remarkable? Yes, because the package was sent directly to his QTH, something that wouldn't have happened several years ago. They would have been stockpiled, and posted in bulk at annual intervals to the WIA Federal Office.

[*It's very nice to see direct communications by more than just the airways.—C.C.C.*]

Ireland. Congratulations to Dave Moore EI4BZ, editor of the *Irish Radio Transmitters Society Newsletter*, on his receipt of the Arup Cup from the Society in honor of his efforts in producing the monthly newsletter.

[*It's always a pleasure to read a well-prepared newsletter, and Dave certainly deserves recognition.—C.C.C.*]

Switzerland. The 13th Plenipotentiary Conference of the International Telecommunication Union (ITU), which met for almost six weeks (23 May–30 June) at the Acropolis in Nice (France), drew to a close with the signature of the Union's new Constitution and new Convention on the evening of Friday, 30 June.

Over 1,000 delegates from 143 of the 166 ITU Member countries attended the Conference, as well as observers from other international organizations.

The Conference, which is the ITU's supreme body and meets every five or six years, had to adopt a Constitution and a Convention to replace the International Telecommunication Convention adopted at Nairobi in 1982, an international treaty binding upon the States Members of the Union.

The Conference also had to review the structures, methods and resources of the ITU with a view to securing the operation and development of world communications in the 1990s and beyond. Telecommunications technology has grown more vigorously in the seven years since the last Plenipotentiary Conference than in the previous 70 years. The Conference was therefore required to make decisions crucial for the future of the Union and international telecommunications, in the fields of frequency sharing and use, regulation of services, standardization of communication equipment and systems, and telecommunications development in the Third World.

Seven Conferences were programmed by the Nice Conference for 1989–1995: (1) The Second Session of the Regional Administrative Conference for the Planning of VHF/UHF Television Broadcasting in the African Broadcasting Area and Neighbouring Countries (Geneva, 13 November–8 December 1989). (2) A two-day Regional Administrative Conference to abrogate the Regional Agreement for the African Broadcasting Area (Geneva, 1986), Geneva, 4–5 December 1989. (3) An extraordinary Plenipotentiary Conference (Geneva, two weeks) depending on the decision taken by the Administrative Council in its 1991 session. (4) A World Administrative Radio Conference on frequency allocations in certain bands: 2–30 MHz for additional allocations to the broadcasting service; 0.50–3.0 GHz for allocations to the land-mobile, mobile-satellite, direct broadcasting-satellite, space research and space operation services; and 11.7–23.0 GHz for allocations to the high-definition television broadcasting-satellite service (Spain, 1992, four weeks and two days). (5) A World Administrative Radio Conference on matters related to the HF broadcasting service, HFBC (Geneva, 1993, four weeks). (6) A Regional Administrative Radio Conference to establish criteria for shared use of the VHF and UHF bands allocated to the mobile service, the broadcasting service and the fixed service and, if necessary, to plan the broadcasting service in all or part of Region 3 and the countries concerned in Region 1, to be decided by the Administrative Council after consulting the Members concerned. (7) An ordinary Plenipotentiary Conference (Japan, 1994, five weeks), to be confirmed by the Administrative Council in 1991.

[*Within several of the above Conferences lie the possibilities of losing or gaining frequency spectrum for the worldwide amateur community. It behooves all of us to become known to our country's representative of the ITU and make our desires known. Also insure that your country's national ham organizations are aware of the importance of these conferences. As we gain more information on the ITU Representatives, we will put this info on the 73 BBS (603-525-4438, 300/1200 baud, 8 data bits, no parity, and one stop bit) for your viewing and/or downloading pleasure. You can also write:* ITU, Place de Nations, CH - 1211 Geneve 20, Switzerland *for more information.—C.C.C.*]

USA. We received the following information about International Amateur Radio Network (IARN) from Glenn Baxter K1MAN.

"The primary purpose of IARN is to organize the amateur radio response during international emergency communications crises. The secondary purpose is to promote the utility of amateur radio in all areas, including public service, international good will, and education.

"IARN was born on September 19, 1985 with the devastating earthquake in Mexico City. The organization has also been involved in emergency communications with the volcano eruption in Columbia, the 1986 earthquake in El Salvador, the 1987 earthquake in Los Angeles, the 1988 hurricane Gilbert hitting Jamaica, and the 1988 earthquake affecting Soviet Armenia. Many other smaller scale emergencies have used the services of IARN. IARN has been recognized as one of the major worldwide organizations which manage multination amateur radio emergency response."

You can get further information by contacting: IARN, 1 Long Point Road, Belgrade Lakes, Maine 04918, USA. Tel. (207) 495-2215;

Calendar for November

1—National Day, Algeria, Antigua (24th for Zaire, 28th for Mauritania, 30th for Barbados and Benin)
3—Culture Day, Japan; Independence Day, Panama (18th for Morocco, 21st for Somali Democratic Republic, 22nd for Lebanon, 24th for Zambia, 25th for Suriname, 28th for Albania)
4—Flag Day, Panama
5—First Cry for Independence, El Salvador
6—Green March Day, Morocco
7—Election Day, USA; October Revolution Day, USSR
8—Queen's Birthday, Nepal
11—Veterans Day, USA; Armistice, France; Remembrance Day, Canada (12th for Bermuda, 13th for Great Britain
14—Dynasty Day, Belgium
15—Proclamation of the Republic, Brazil (29th for Yugoslavia)
17—Army Day, Zaire
18—National Holiday, Oman
19—Day of National Mourning, Germany; Latin American Week begins
20—Revolution Day, Mexico
22—Day of Prayer and Repentance, Germany
23—Thanksgiving Day, USA; Labor Thanksgiving Day, Japan
30—St. Andrew's Day, Scotland

Photo A. World Lithuanian Amateur Radio Net.

Photo B. Lithuanian Flag and Olympic Emblem.

FAX (207) 495-2069; 14.275 and 21.275 MHz.

Paul Pauliukonis KB1TY provided us with information on the International Lithuanian Amateur Radio Net.

The International Lithuanian Amateur Radio Net meets weekends on 21.330 MHz at 1500 GMT or 1800 GMT, depending on propagation. When the 10 meter band to Northern Europe is open, the net then meets weekends on 28.444 MHz at 1400–1500 GMT.

The purpose of the net is to provide an opportunity for radio amateurs of Lithuanian descent the world over to meet each other, to rag-chew, and to practice speaking the Lithuanian language.

Currently the net has about 80 members, with a good 15–20 participating in the weekend operations. Net coordinator is UP1BZZ (Northern Lithuanian Group which placed second in the 1988 CQ WW Contest), assistant coordinators are N8AUM, N6SFD, and G4BYW. KB1TY is the secretary.

Historic Lithuanian Sailboat Crossing of the Atlantic Ocean

The International Lithuanian Amateur Radio Net, founded a year ago, volunteered to serve as a message transfer center between three sailboats and shore stations during the former's crossing of the Atlantic Ocean.

Three Lithuanian yachts, *Audra*, *Daile*, and *Lietuva*, flying the tricolor flag of Lithuania, set sail from Klaipeda, Lithuania, for New York on May 13, 1989, to commemorate the tragic transatlantic flight of the American-Lithuanian Heros, Darius and Girenas. In 1933, the two pilots attempted to make a nonstop flight from New York to Kaunas, Lithuania. After successfully crossing the Atlantic, they later crashed in eastern Germany only several hundred miles from their destination.

The three yachts successfully crossed the Atlantic and arrived in Atlantic Highlands, New Jersey, on June 19–21. From there they were triumphantly escorted to New York's South Street Port on June 24. During the entire crossing, the Net, composed of amateur radio operators in Lithuania and in the United States, as well as in Bolivia, Israel, and England, maintained an almost daily contact with the boats, relaying messages and information. Contact was lost only during several days of very poor propagation.

The following amateurs and club stations participated and contributed much time and effort to make this undertaking a huge success: 4Z4KX, CP8AL, G4BYW, W1HNF, WA1JZS, KB1PI, KB1TY, K2SRK, K3JA, W3POA, K3STM, N8AUM, KA9PVD, W9QVE, UP1BZO, UP1BWW, UP1BZZ, UP2BKX, UP2BH, UP2BR, UP2BLX, UP2BBZ, UP2CS, UP2BO, UP2BTE, UP3BH, UP3BK and UP3BM.

Photos A and B show a pennant printed in Lithuania by UP1BZZ and distributed to participants of the net. The front side contains the coat-of-arms of Lithuania with the inscription, in Lithuanian, "World Lithuanian Amateur Radio Net." The reverse side has the Lithuanian flag, a shield with the Lithuanian Olympics emblem, and the words "Lithuanians we are born, Lithuanians we should remain." Interestingly enough, anyone caught distributing these national symbols a year ago would have been jailed. Now they are freely allowed to print them.

For more information on the organization, write Paul Pauliukonis KB1TY, PO Box 321, Strafford NH 03884, USA.

[More evidence of the worldwide openness continuing.
—C.C.C.]

CZECHOSLOVAKIA

Rudolf Karaba OK3PC
Gogol'ova 1882
955 Ol Topol'cany
Czechoslovakia

Rudy reports the results of the OK-DX Contest 1988. The winners of the single operator categories are: All Band UA1DZ, 1.8 MHz UC2OM, 3.5 MHz LZ1BB, 7 MHz LZ1NK, 14 MHz YU1KQ, 21 MHz UB5IJG, 28 MHz OK3CBU. The winner of the Multi Operator All Band category is 3W8CW.

The 1989 OK-DX Contest is the first weekend in November 1989.

SOUTH AFRICA

Peter Strauss
PO Box 35461
Northcliff 2115
South Africa

Johannesburg. The delegates attending the annual general meeting of the South African Radio League voted with an overwhelming majority for the Headquarters of the SARL to be moved from picturesque Cape Town to the business centre around Johannesburg. One of the major considerations was the lack of voluntary manpower to adequately manage the affairs of the 2500 members in the Republic. The general feeling of the delegates, who voted for the move, was that with most amateurs situated in the Johannesburg/Pretoria area, better regional representation could be implemented without any serious cost increases.

The League owns a small building in Cape Town accommodating the Book Shop, QSL bureau, and SARL Headquarters administration.

To move the Headquarters 1000 miles is not an easy task. To meet the deadlines and continue to provide members with continuity of service, the delegates appointed an interim management committee. The original three-member ber team was enlarged and managed the League affairs until the results of a national postal election were declared on 17 June 1989.

During its inaugural meeting held at the Johannesburg Amateur Radio Center (JARC), office bearers were elected, and they made a number of far-reaching decisions.

In the past, South African Radio Amateurs had to paste a QSL sticker on all outgoing cards. These stickers had to be bought from the League or the local Branch at a cost of about US $0.02 each. The trouble to obtain the stickers, even though the amateur was a member and still "had to pay to QSL," caused many amateurs to fail to QSL via the bureau. Nonmembers foiled the system by getting stickers from members.

A new QSL system was one of the first "hot potato" decision taken by the new team in Johannesburg. With immediate effect, no QSL stickers will be required for members. All outgoing cards will be checked against membership records. Nonmembers receiving or dispatching cards will have these returned.

For sorting QSL cards, an innovative solution was presented to the newly elected SARL Councillors and accepted: "The Bureau is now run by a group of handicapped people known as the 'Young Adult Learning and Earning,' YALE, under the supervision of Len Silberman ZS6BYE and an occupational therapist. While the cost of this service is considerably less than the employment of QSL Bureau staff, the SARL is also making a worthwhile contribution to the YALE project. "The first batches of cards have already been mailed," Hans v.d. Groenendaal ZS6AKV told our reporter.

Novice License for South Africa Soon? With attention given in the USA to the no-code license, South African radio amateurs are focusing their attention on the creation of a Novice Li-

cence. Presently, South Africa features a full CEPT class I compatible license, callsign prefix ZS, and a restricted license. The restricted license, compatible with the CEPT class II, permits operation on frequencies above 30 MHz. The technical exam is identical for both license classes, but the ZS license requires code at 12 wpm.

Considerable thought has been given to the creation of a license to encourage young people of **all races** to pass the radio amateur exam (RAE). The minimum entrance level, similar to US General/Advanced class theory, was considered a problem for young beginners. The bursaries offered by the South African Amateur Radio Trust have helped to increase the profile of the amateur radio service among young people in South Africa.

Once a proposal, based on the experience in other countries with Novice licenses and local conditions, has been formulated, the introduction of such a license is not expected to take long.

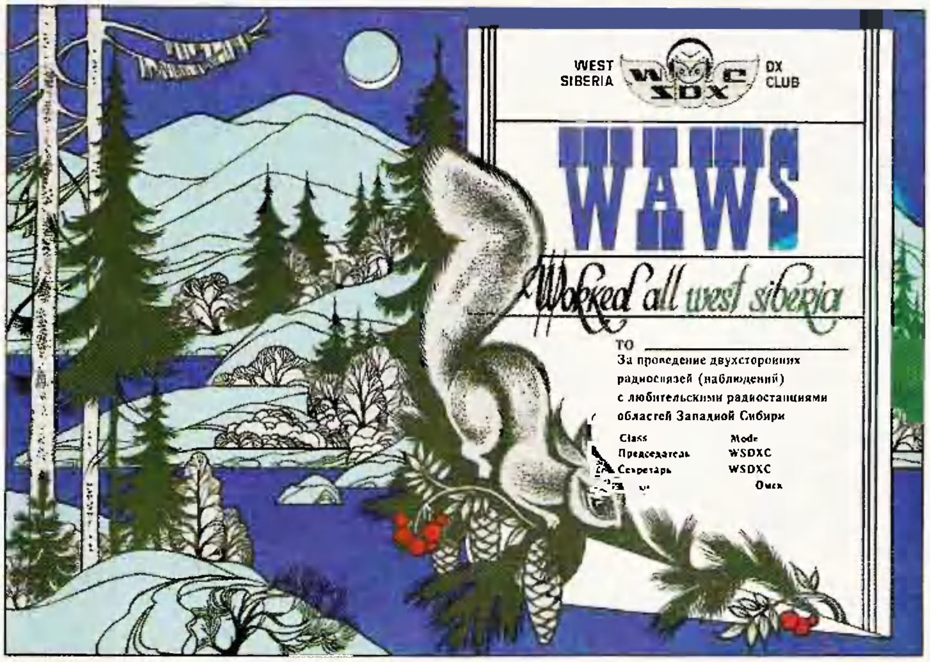


Photo C. WAWS Worked All West Siberia Award from the West Siberia DX Club, sent by UA9MA. Again loosely translated by Bryan NS1B: "(To the award recipient) for successful two-way contacts (observed) with amateur radio stations in the oblasts of Western Siberia."

Fund-Raising Scheme Attracts Contributors. Recently, the Johannesburg Branch of the SARL launched a fund-raising scheme—the Johannesburg Branch 500 Club. Membership is easy; you just make a one-time contribution of Rand 500 (US $200) to the fund. Members receive a handsome certificate in recognition of their donation. The funds are being used to help finance the move of the national offices to Johannesburg, and for the purchase of essential office equipment, including a FAX machine. Contributions should be sent to SARL 500 Club, PO Box 13754, Northmead, 1511 South Africa. 73

Continued from page 13

The key is made from a microswitch with a lever arm. If you prefer, any key will do. Don't use an electronic keyer, though, because all the current for the transmitter passes through the key! In any event, keep the key wires under one foot long for best results. It's probably not a good idea to mount the key on the radio cabinet, because the vibration produced from pounding on it may cause chirp or drift.

Parts List

Part	Type	Source and No.
Flavoradio		RS 12-201, 12-202, 12-203
Q1, Q7	MPF-102	RS 276-2062
Q8	M3819	RS 276-2035
Q9	BS170	Digi-Key BS170
Q10	2N2222A	RS 276-2009
Q11	IRF511	RS 276-2072
U1	TLC555	RS 276-1718
D4	1N914	RS 276-1122
D5	6.1 V zener	RS 276-561
X1	455 kHz	Digi-Key P9942
L3, L5	T50-2	Radiokit
L4	100 µH	RS 273-102
L6	10 mH	Digi-Key M7100
TC1, TC2	6-50 pF	RS 272-1340
TC5	0-365 pF	RS 272-1337
S2	3PDT	Digi-Key SW121-ND
Heatsink	TO220	RS 276-1363
C123	10 mF	
C101, C116, C117, C122, C124	0.1 mF	RS 272-109 (5 in pack)
C102, C103, C115	0.01 mF	
C104, C105, C118, C121	0.001 mF	
C108, C120	220 pF	
C111, C125	100 pF	
C109	47 pF	

All 33 pF and lower caps are from the RS 272-806 assortment:

C106	5 pF
C107	18 pF
C110	10 pF
C112	33 pF
C113	8 pF
C114	2 pF
R101, R102	1k
R103, R114	10k
R104, R107, R115	1 Meg
R105, R109	220
R106	47k
R108, R112	100
R110, R111	470
R113	100k

Sources: Digi-Key Corporation, 701 Brooks Ave. South, PO Box 677, Thief River Falls MN 56701-0677. (800) 344-4539. Radiokit, PO Box 973, Pelham NH 03076. (603) 635-2235.

Tuning Up

Tune-up is very easy. First, mount the rig in its cabinet. Now, install the batteries, set the T/R switch to receive, and connect an antenna. Turn on the power and set the volume up about two-thirds. You should hear some hiss or noise. Set the RIT tuning cap (TC5) to its midway point. Set the main tuning cap to its fully meshed position (counterclockwise, when viewed from the front of the radio). Use your other HF rig in the CW mode to transmit a 3.695 MHz carrier, at the lowest possible power level, into the dummy load. Referring to Figure 1, adjust TC1 until you hear the carrier tone. Adjust IFT1 and IFT2 for the loudest tone. Now, stop transmitting.

Set the main tuning cap to the midway point. Carefully remove some of the wax holding the antenna coil to its rod, so that you can slide the coil back and forth. Pull it out so that it is just hanging on the end of the rod. With the plastic end of a screwdriver, slowly push it onto the rod and listen for signal and/or noise peaks. The first one is the undesired image frequency, and the next one is the one you want. You'll hear the static and signals rise dramatically. It's a pretty steep peak, and it may take more than one try to get it just right. When you've got it, use a daub of nail polish to hold the coil in place.

Now, set the main tuning cap fully clockwise. Use the HF rig to transmit a 3.755 MHz carrier into the dummy load, and adjust TC3 (on the back of the main tuning cap) until you hear the tone at about the same pitch as before. Note: The Flavorig has no sideband filter. Thus, it receives on both sides of zero-beat. Be sure to set TC3 so that you hear the carrier on the same side of zero-beat as you did when adjusting TC1. At this point, you may wish to readjust IFT1 and IFT2 while listening to signals or noise on the band, without using the HF rig, to obtain maximum sensitivity. This completes receiver alignment.

To align the transmitter, return the HF rig to receive, reconnect it to the antenna, and set it to 3.720 MHz. Connect the Flavorig to the dummy load or a 47Ω resistor, and set the T/R switch to transmit. Do NOT key the rig. Adjust TC2 until you hear the Flavorig's oscillator on the HF rig. Now, set L2 to the middle of its range. Key the rig and adjust L2 for maximum output as observed on the HF rig's S-meter. You may have to retune the HF rig slightly, as the Flavorig's oscillator shifts a tiny bit when keyed.

If you hear a loud rushing noise from the Flavorig's speaker, check the phase of the connections to L2; you may have reversed one. If the HF rig's S-meter is pegged, disconnect its antenna or switch in the RF attenuator to reduce the reading.

Now, use the HF rig to transmit a CW carrier on 3.695 MHz, and tune it in on the Flavorig (set to receive, of course), on the high side (clockwise) of zero beat. Set the HF rig to receive, and the Flavorig to transmit. Key the rig and adjust TC2 until you hear the tone on the HF rig. Then, set the HF rig to 3.755 MHz, and repeat the procedure, this time adjusting TC4 (on the back of the main tuning cap).

This completes the alignment of the Flavorig. The total tuning range is 3.695 to 3.755 MHz, covering 5 kHz on each side of the Novice segment. If you're a Novice or Tech, be careful when transmitting near the band edges!

Notes

Those familiar with radio design may find the Flavorig a bit odd. For instance, there is no electrical coupling between the oscillator and Q1, the receive RF amp, and no explicit mixer. Coupling is performed by the proximity of the oscillator to the antenna coil. This method produces the simplest, most sensitive receiver, and also eliminates oscillator pulling on strong signals.

Also, the wire coupling wound around the antenna coil has no ground connection. There's more than enough coupling as it is. And there's no tuning cap across the antenna coil. The FET's internal capacitance, and the coil's own distributed capacitance, resonate the coil nicely on the 80 meter band, with sufficient bandwidth to cover the Novice segment without further tuning.

Tracking of the TX and RX frequencies across the band is much more difficult to achieve in a superhet than it is in a direct conversion receiver. Careful alignment of TC1, TC2, TC3, and TC4 will result in fairly good tracking, but it may vary by a few hundred Hertz from edge to edge. Fortunately, you can use the RIT control to compensate, should it become a problem.

The VFO is very stable after about a 10 minute warmup. If you hear significant drift or instability, check that all wires from the oscillator coil and going to the T/R switch are kept short and held rigid.

The final transmit amp uses a power FET. It is very stable with all but the most extreme SWR. At 13.8 volts, output will be about 5 watts. At 12 volts, 3.5 watts. And at 10 volts, a still-respectable 1.5 watts!

When using a longwire antenna with a tuner, be sure to ground the rig, or it may become hot with RF. (Yes, 5 watts can hurt!) Also, avoid long keydown periods, as the transistor can overheat. The heatsink will get warm in normal operation, but should not get burning hot. If it does, consider a larger heatsink.

Conclusion

Enjoy your Flavorig. For such a simple beast, it works remarkably well. Once you make a contact on a rig you built yourself, you may find that '940 gathering dust while you experience the thrill of pounding out your call on a 5 watt box! 73

Michael Geier KB1UM writes the "Ask Kaboom" column. You can reach him at 7 Simpson Court, S. Burlington VT 05403.

73 Book Review

Reviewed by Alida M. Jatich KA9KAG

Computing Across America

A view of Steven K. Roberts N4RVE's book.

"Suburbia is not a place; it's a state of mind. . . You live in suburbia when the cycle of work and play becomes dangerously unbalanced in favor of work." (*Computing Across America*, page 3.)

If you're like me, there have been times when you've felt that your lifestyle is too confining. Do you spend so much time maintaining your home, your car, and other possessions that it seems those possessions own you? Does your work really offer you excitement, creativity, contact with other people, and a sense of adventure?

Or do you just wear yourself out, go home, eat supper, do chores, and fall asleep in front of the TV? This world is full of colorful places and fascinating people. Do you feel you have to wait until you retire to see them for yourself? If you've ever had the impulse to sell your house and car, quit your job, and travel for the next few years, then you'll probably enjoy this book.

Readers of *73 Magazine* will be familiar with Steve Roberts' articles about the technical aspects of his tour of the United States. Roberts' recumbent bicycle carries a cornucopia of ham gear, computers, and modems, together with a stereo, a TV, and other goodies, powered by two banks of solar cells and protected by a sophisticated alarm system. The current version of his bicycle even contains an eight-switch ASCII keyboard embedded in the handlebars. Roberts can actually enter characters into his computer while pedaling the bicycle, which helps him continue to earn a living as a writer while on the road.

This book does not contain circuit diagrams and technical discussions of Roberts' gear. For that, keep watching the pages of *73 Magazine*. Rather, it is the story of Roberts' adventures: the people he met and the places he saw on his first trip.

Roberts seems to be something of a romantic soul. This book was written almost from a poet's point of view. He acquired so many girlfriends on his first journey that the book could almost have been called "Womanizing Across America." Roberts recalls each of these relationships in a gentlemanly and gallant way. OMs may enjoy fantasizing about such exploits, but as a YL, I was somewhat taken aback at the number of broken hearts he left behind. But he wasn't ready to settle down. The call of the open road, which he calls "the other woman," proved too strong a lure.

On his journey, Roberts encounters the conflicts between security and freedom, comfort and adventure, and the desire for permanent relationships and the reluctance to give up future options. He acutely observes the lifestyles and customs prevalent in the places he visits. Some passages are moving, such as his first meeting with his biological mother. Some are informative, such as his tour of the National Weather Service station in Louisiana, and his description of how he used the Compuserve online network. Others are humorous, such as an unexpected encounter with a rattlesnake in New Mexico.

My own decision to buy this book was influenced by the fact that I had also enjoyed two other books of this genre, *A Walk Across America* by Peter Jenkins, and *Blue Highways*, by William Least Heat Moon. These books cover similar territory, both literally and figuratively—traveling through America as an adventure, an education, and a rite of passage. Roberts even stayed in Lake City, Colorado, which had been made famous in Peter Jenkins' book.

Like Jenkins and Least Heat Moon, Roberts acquires more confidence on his journey and takes the opportunity to rid himself of stereotypes, prejudices, and fears. Since Roberts' personality and outlook differs so much from that of the other two authors, *Computing Across America* presents an original point of view. Roberts appears to have somewhat more of an ego than the other two authors. He is also more outgoing. He actively seeks emotional involvement, attention, and the limelight. He also appreciates the possibilities of using technology in the service of greater freedom.

Steve Roberts is still traveling and writing, but now he has a traveling companion, Maggie Victor KA8ZYW. (She appears in the epilogue of *Computing Across America*.) This book mentions their getting ham licenses, but doesn't say much else about ham radio. A book such as this wouldn't be the place to discuss the technical aspects of ham radio, but ham radio isn't just equipment and technology. It's also communication—meeting, getting to know, and working with other people. In future books, I hope that he and Maggie share some ham radio stories with us.

I recommend this book. Where do you buy it? If you missed the opportunity to buy an autographed copy from the author at the Dayton Hamvention, you can order it by mail from *Computing Across America Publications Center, PO Box 2390, Santa Cruz CA 95063*. Softcover, $9.95 and hardcover, $15.95. Add $2 postage and handling per order. 73

SPECIAL EVENTS

Ham Doings Around the World

SOUTHFIELD MI
NOV 5

The Oak Park ARC presents its annual Swap-N-Shop at the Southfield Paviilion Center. Free parking. Admission $4 each. Kids under 12 free. 8-ft. tables $10 each. Reservations required. Allow 2 weeks to process reservations. Send payment to *Oak Park ARC, Inc., PO Box 1422, Royal Oak MI 48068.*

SUMTER SC
NOV 11

The Sumter ARC will sponser a late fall hamfest at the Sumter County Exhibition Center. 20,000 sq. ft. indoor flea market, handicap access. Advance tickets $4, door $5. Talk-in on 147.015. Contact *SARA, P.O. Box 193, Sumter SC 29151-0193* or *Ted Kreipe KB4FIQ, (803) 773-5189.*

NORTH HAVEN CT
NOV 12

The South Central Connecticut ARA will sponsor their tenth Annual Flea Market at North Haven Park and Recreation Center. Sellers 7 AM, Public 9 AM–3 PM. Wheelchair accessible. Admission $3, advance tables $12, door $15. Table reservations with a check must be received by Nov. 2. No reservations by phone. Talk-in: 146.01/.61/.61. Send SASE to *SCARA Flea Market, PO Box 81, North Haven CT 06473* or telephone *Brad Oestreicher WA1TAS, (203) 265-6478, 7–10 PM.*

ROCKFORD IL
NOV 12

Rockford ARA & Experimental ARA will sponsor Rockford Hamfest—'89/Computer Fair at the Forest Hills Lodge. Commercial exhibits and flea market inside, tailgating outside. Advance tickets $3, door $4. Tables $7 advance, $10 at door. For booths and tables call *Lonnie Miller (815) 623-7576*. For general information call *Paul Klein (815) 226-4696*. Send SASE for reservations/tickets to *Rockford Hamfest, P.O. Box 10003, Rockford IL 61131.*

HANNOVER GERMANY
NOV 11–12

The 8th Ham-fair INTERRADIO, sponsored by the Ten-Tec Amateur Radio Equipment Owners Group (TTOG), will be at the Hannover exhibition grounds, to found a special interest group for Ten-Tec equipment owners. TTOG is totally independent of Ten-Tec Inc. in Tennessee, USA. For more information send an SASE and 2 IRCs to *TTOG Jurgen K. Jagelle. DF 9 Ai, Garkenburgstrasse 52, D-3000 Hannover 81, Federal Republic of Germany.*

FORT WAYNE IN
NOV 12

The Allen County Amateur Radio Tech. Society will sponsor the 17th annual Fort Wayne Hamfest at the new Allen County War Memorial Coliseum Exposition Center starting at 8 AM. Tickets are $3.50 advance, $4 at the door. Parking $1. Talk-in on the 146.88 (-) and 443.80 (−) repeaters. Standard tables $12., premium tables $25. AC power extra. For more info write *AC-ARTS, PO Box 10342, Fort Wayne IN 46851.*

SINGAPORE
NOV 17–19

The 17th Southeast Asia Network Convention (SEANET 89), held in Singapore, includes demo of new technology-interactive communication system "TELEVIEW". Contact *Organizing Committee, SEANET '89, Maxwell Road PO Box 2728, Singapore 9047.*

TAMPA FL
NOV 18–19

The Annual Suncoast Convention, sponsored by the Florida Gulf Coast Amateur Radio Council, will be held at Curtis Hixon Convention Center. Inquire about booth spaces, swap tables and convention rooms as soon as possible by calling *(813) 442-3830 afternoons.*

WASHINGTON PA
NOV 19

The Washington Amateur Communications Club will hold its 2nd Annual Tri-State hamfest indoors at The Meadows from 8 AM–3 PM. Admission $1, children under 12 free. Talk-in: 145.49/W3CYO-Rptr. and 146.52. Contact *Carl Stark KD3KH (412) 225-5684 or Jim Mounts KA3EBX (412) 941-2670.*

NORTH OLMSTED OH
NOV 26

The North Coast ARC is holding its Swapfest at the North Olmsted Community Cabin from 9 AM to 2 PM. Talk-in on the 145.29 and 224.84 repeaters. Contact *Chuck Early K8RSH (216) 777-1595.*

SPECIAL EVENTS STATIONS

CALVARY GA
NOV 4 (Rain Day NOV 11)

The Albany ARC will operate station W4MM at 1200Z–2400Z in celebration of the 18th Annual Mule Day Event. Frequencies: 3.975, 7.245, 14.250, 28.383. For Certificate send large SASE to *AARC, Inc., PO Box 70601, Albany GA 31705.*

CLAREMORE OK
NOV 4–5

Rogers County Wireless Assoc. will operate N5OK from the Will Rogers Memorial, 1300Z–2300Z. Frequencies: lower 15 kHz of the general band on 20 and 15 meters, and 28.430. Send QSL and SASE to *RCWA, Rt. 3, Box 793, Claremore OK 74017.*

BUTTE MT
NOV 6–12

The Butte ARC will operate W7FO to celebrate the 100th brithday of Montana's statehood. Frequencies: 3.890, 7.280, 14.280, 21.370, and 28.470. For certificate send 9 x 12 SASE to *Butte ARC, PO Box 4036, Butte MT 59701.*

NOV 11–12

The Montana Centennial QSO Party is being sponsored by the Butte ARC from 0000Z–2400Z. 10–80 meters phone and CW. Frequencies: PHONE—3.890 7.280 14.280 21.370 28.470; CW-40 kHz from low end; NOVICE—25 kHz from low end. Framable certificate to highest scorer in each state. Mail logs (to be received by Dec. 12) and legal size SASE to *W7FO Butte ARC, PO Box 4036, Butte MT 59701.*

Number 31 on your Feedback card

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QSLs TO ORDER. Variety of styles. colors, card stock. W4BPD QSLs, PO Drawer DX, Cordova SC 29039. BNB260

THE DX'ERS MAGAZINE Up-to-date, informative, interesting. Compiled and edited by Gus Browning W4BPD, DXCC Honor Roll Certificate 2–4. Send for *free* sample and subscription information today. PO Drawer DX, Cordova SC 29039. BNB261

AZDEN SERVICE by former factory technician. Fast turnaround. PCS-300 NiCads $36.95. Southern Technologies Amateur Radio, Inc., 10715 SW 190 St. #9, Miami FL 33157. (305) 238-3327. BNB262

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SB-220/221 OWNERS: 17 detailed mods which include 160–6 meter operation, QSK, +enhanced p.s. 50% rebate for new mods submitted! 9 pages of 3-500Z tech info. $11 postpaid.—Info. SASE, BOB KOZLAREK WA2SQQ, 69 Memorial Place, Elmwood Park NJ 07407. BNB581

ELECTRONIC KITS & ASSEMBLIES. For our latest catalog, SASE (45¢) to: A&A Engineering, 2521 W. LaPalma, #K, Anaheim CA 92801. BNB624

HT-CLONE BATTERIES: ICOM: BP-3S Double BP3 "Wall Chargeable" $43.95, BP5 $42.95, YAESU: FNB2 $21.95, SANTEC: 142/442/1200 (3 Pin) $22.95. "REBUILDING: SEND-UR-PACK" Icom BP3 $20, BP5 $28, BP7/8 $34, BP70 $35, Yaesu FNB4/4A $37, Kenwood PB21 $18, PB25/H/26 $25, T-T 2991 $28. "U-DO-IT REPAIR INSERTS" ICOM: BP2 $18.95, BP3 $16.95, BP5 $22.95, BP7/BP8 $28.95, KENWOOD: PB21 $12.95, PB24/25/26 $19.95, AZDEN 300 $19.95, YAESU: FNB4/4A $32.95. TEMPO: S1,2,4,5,15/450 $22.95, 12V/5Ahr PORTA-PAC W/CHGR $49.95, "ANTENNAS" 2MTR 5/8-Tel/BNC $14.95. "TELEPHONE / PAGER & COMMERCIAL PACKS" "FREE CATALOG." $3 Shipping/order. PA +6%, Visa–M/C +$2. (814) 623-7000. CUNARD ASSOCIATES, Dept. 7, R.D. 6 Box 104, Bedford PA 15522. BNB628

ROSS' $$$$ NEW November SPECIALS: KENWOOD TS-940S/WAT $2059.90, TS-140S $789.90, TM-231A $389.90, TM-701A $504.90, TM-411A $339.99, TS-711A $839.90, TW-4100A $459.99, TM-731A $633.90; TEN-TEC 585 $1878.50, 238 $319.90, 255 $178.90, 561 $1249.90, 562 $1789.90; ICOM IC-2SAT $377.90, IC-38A/WHM-14 $328.99, IC-3210 $599.90, IC-735 $969.90, IC-781 $5269.90, IC-900 $458.99; YAESU FT-747GX $719.90, FT-73RTT $279.90, FT-209RH $276.99, FT-736R $1649.99; AMP SUPPLY LK550-NT/C $1999.90, LK450-ZC $899.90; CUSHCRAFT ARX2B $41.50, ARX-450B $42.50, A50-5 $102.90, AFM-44DA $64.90; AEA PK-64/WHFM $149.99. ALL L.T.O. (LIMITED TIME OFFER) LOOKING FOR SOMETHING NOT LISTED?? CALL OR WRITE. Over 8780 ham-related items in stock for immediate shipment. Mention ad. Prices cash, F.O.B. PRESTON. HOURS TUESDAY–FRIDAY 9:00 TO 6:00, 9:00–2:00 P.M. MONDAYS. CLOSED SATURDAY & SUNDAY. ROSS DISTRIBUTING COMPANY, 78 SOUTH STATE, PRESTON ID 83263. (208) 852-0830. BNB654

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- [ ] **Individual (noncommercial)** .... **50¢ per word**
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No discounts or commissions are available. Copy must be received in Peterborough by the first of the second month preceding the cover date. Make checks payable to *73 Magazine* and send to: Donna DiRusso, **Barter 'N' Buy, Box 278, Forest Road, Hancock, NH 03449.**

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INDIVIDUAL PHOTOFACT FOLDERS. #10 to #1400, $4.00. #1401 up, $6.00. Sam's books, $7.00. Postpaid. Allen Loeb, 414 Chestnut Lane, East Meadow NY 11554. BNB766

AVANTEK ATF10135 $12.00, MMIC's, P.C. board, SASE: WA3IAC, 7148 Montague St., Philadelphia PA 19135. BNB771

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PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

It looks as if the best week of the whole month will be from the 18th to the 25th. The second and third weeks of the month are expected to be fair to poor, and the first and last weeks will probably average fair.

Solar flux and sunspot activity increase rapidly these days, and solar events, such as flares, are commonplace. Ionospheric upsets and magnetic storms become the rule rather than the exception.

All this activity means that events change rapidly, and propagation conditions can be quite good one day and quite poor the next.

For best results, monitor WWV at 18 minutes after each hour. Boulder "K" index values, changing up or down, give trends during each day, while Planetary "A" index values give day-to-day changes. Decreasing "K" and "A" indexes mean a quiet(er) magnetic field, while increasing indexes mean a more active one.

Use the Overall Band/Time chart for predicting the possibility of band openings to various parts of the world at different times—and then use your daily forecast to see if there is a good likelihood that those possible openings may, in fact, be usable. In the "best band to use" chart, the following parenthetical notes apply: (1) try 40 or 30 meters; (2) try 15 or 18 meters; (3) try 10 or 12 meters; (*) try 80 meters. With WARC bands active, you may use 30 and 40 together; 10 and 12 together; and 17 and 20 together for openings shown on the chart. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15*	20	20	20	—	—	—	—	—	—	—	15*
ARGENTINA	[illegible]	15	20	20	40	—	—	10	—	—	10	10
AUSTRALIA	10	15	20	20	—	40	20	20	—	—	—	10
CANAL ZONE	15	40*	40	40*	40*	—	20	10	10	10	10	10
ENGLAND	20	40	40	40	—	—	20	10	10	10	15	20
HAWAII	10	15	20	20	40*	40	20	20	—	—	—	10
INDIA	20	20	—	—	—	—	—	15	—		—	—
JAPAN	15*	20	20	20	—	—	—	—	—	—	—	15*
MEXICO	15	40*	40*	40*	40*	—	20	10	10	10	10	10
PHILIPPINES			20	20	—	—	20	15*	15*	—		—
PUERTO RICO	15	40*	40*	40*	40*	—	20	10	10	10	10	15
SOUTH AFRICA	40*	20	20	20	—	—	—	—	[illegible]	[illegible]	10	15
U.S.S.R.	—	40	20	20	20	—		10	10	15	20	20
WEST COAST	10	15	20	20	[illegible]	[illegible]	—	—	—	10	10	10

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15	20	20	20	—	—		—	—	—	—
ARGENTINA	15	15	20	20	20	—	—	10	—	—	10	10
AUSTRALIA	10	15	15	20	20	40*	40	20	—		15	10
CANAL ZONE	15	15	20	20	—	40	40	10	10	10	10	10
ENGLAND	—	—	—	—	—	—	10	10	15	15	20	20
HAWAII	15	15	20	20	40*	40*	40	20	—	—	10	10
INDIA	—	20			—	—	—	20*	15	—	—	—
JAPAN	10	15	20	20	20	—	—	—	—	—	—	—
MEXICO	15	15	20	20	—	40	40	10	10	10	10	10
PHILIPPINES	15	—		—	—	—	—	20	10	10	—	—
PUERTO RICO	15	15	20	20	—	40	40	10	10	10	10	10
SOUTH AFRICA	20	20	20	—	—	—	—	—	10	10	15*	15
U.S.S.R.	—	—	20	—	—	—	20	15	15	15	20	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	10	15*	—	20	20	20	20	20	20	20	—	15
ARGENTINA	10	15	15	20	20	20	—	—	10	—	10	10
AUSTRALIA	10	15	15*	20*	20	20	40	—			—	10
CANAL ZONE	10	15	15	40/20	40/20	—	—	—	15*	10	10	10
ENGLAND	—	—	—	—	—	—	—	—	15	20	15	—
HAWAII	10	10	15	20	40*	40*	40	40	15	15	—	15
INDIA	—	[illegible]	—	—	—	—	—		[illegible]	15*	—	—
JAPAN	10	10	—	20	20	20	20	20	20	20	—	15
MEXICO	10	15	15	40/20	40/20	—	—	—	15*	10	10	10
PHILIPPINES	10	10	—	—	—	—	—	—	20*	15	15	—
PUERTO RICO	10	15	15	[illegible]	[illegible]	—	—	—	15*	10	10	10
SOUTH AFRICA	20	20	—	20	—	—	—	—	—	10	15	15
U.S.S.R.	—	—	—	20	20	—	—	—	15	15	20	20
EAST COAST	10	15	20	20	[illegible]	[illegible]	—	—	—	10	10	10

NOVEMBER 1989

SUN	MON	TUE	WED	THU	FRI	SAT
			1 F	2 F	3 F-G	4 G
5 G	6 G-F	7 F-P	8 P	9 P	10 P-F	11 F
12 F-P	13 P	14 P	15 P	16 P-F	17 F-G	18 G
19 G	20 G	21 G	22 G	23 G	24 G	25 G-F
26 F-P	27 P	28 P-F	29 F	30 F-G		

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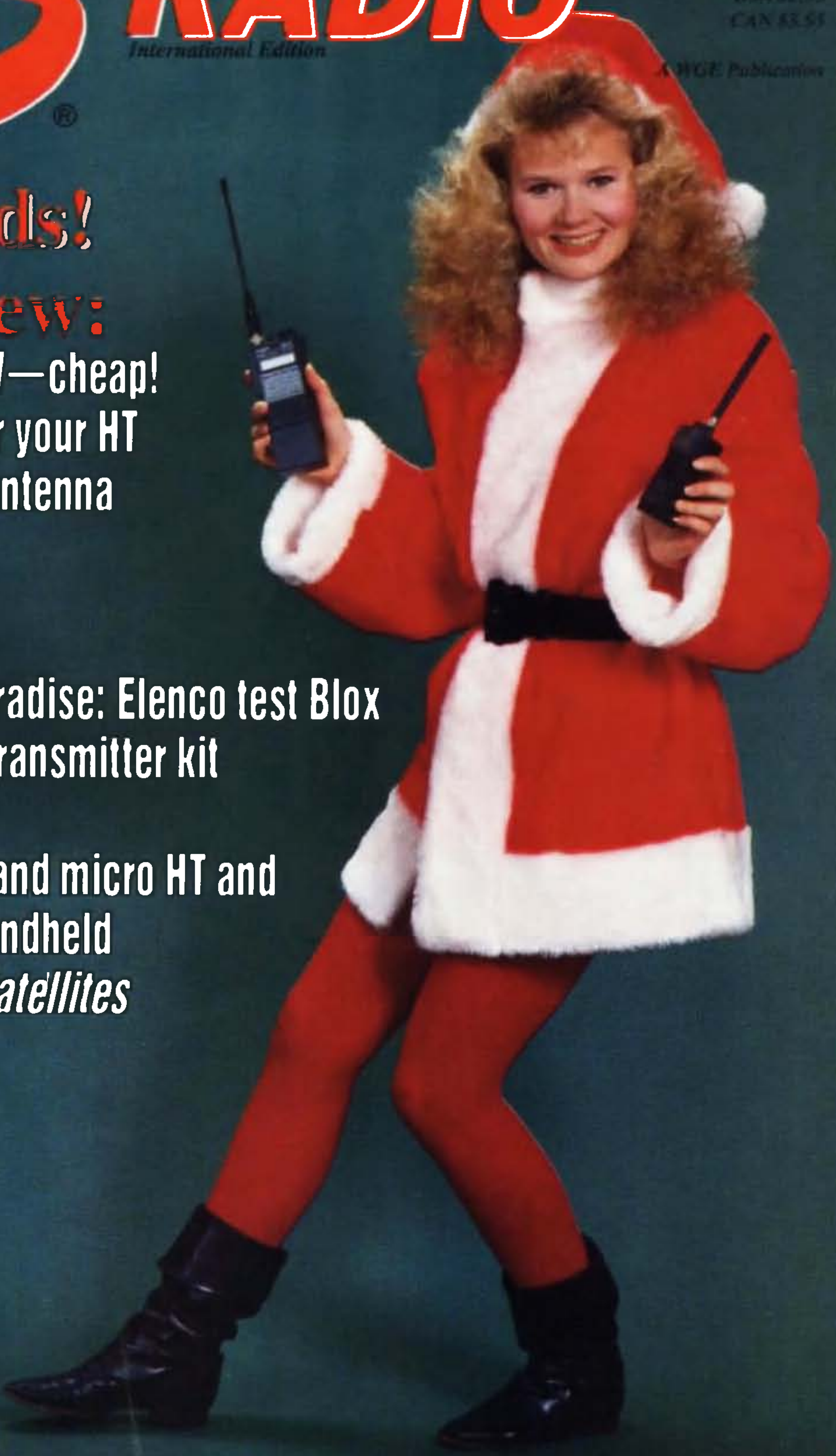

Hand-helds!

Home-Brew:

Atari ST color SSTV—cheap!
Bargain booster for your HT
Under-$1 hamsat antenna
A VOX on your 2AT

Reviews:

Breadboarder's Paradise: Elenco test Blox
Ramsey $30 40m transmitter kit
Tale of two HTs:
Yaesu 470 dual-band micro HT and
ICOM 2SAT 2m handheld
Communications Satellites

WELCOME NEWCOMERS

Walkies!

Have you ever met a ham who didn't own a hand-held transceiver? I doubt it. These radios, known as HTs, handie talkies, walkies, handhelds, squawk boxes, and goodness knows what else, are among the most popular playthings in the amateur radio hobby. They permit us to enjoy radio from any location. Thanks to **repeaters** (see below), a tiny walkie can provide communications over great distances, ranging from ten to several hundred miles! Above all, HTs are just plain fun.

Basics

Almost universally, walkies are **FM** rigs, with the clear, crisp audio associated with that form of modulation. They operate in the **VHF** and/or **UHF** bands, the 2 meter VHF band being the most popular. Their transmitters put out between 1 and 5 watts of **RF** energy, which may not sound like much but is very effective for local use, especially in conjunction with repeaters.

The typical HT has **digital memories** which store frequencies and other operating parameters, making operation easy. It has a rechargeable battery good for a few hours of use after each charge. It comes with a "rubber duck," which is a **helically wound**, rubber-encased, flexible antenna. It is fairly small, so you can clip it to your belt or even drop it in your pocket. It has a **DTMF** Touch-Tone™ pad which permits you to send tones over the air for telephone **autopatch** or other control applications. It may include a subaudible tone or **CTCSS** encoder, enabling access to repeaters which require it.

Psst...Pass it On

The key to the HTs' popularity is the proliferation of repeaters, which are automated stations designed to receive the handhelds' weak signals and retransmit them with much greater power. These stations, usually strategically located on a hill or tall tower, can often be heard up to 60 or more miles away. Due to their large, well-placed antennas, they can receive signals from nearly as far. A small radio with a **simplex** (direct station-to-station) range of only a few miles has the power and range of the repeater, as long as it can reach the big station.

Who operates repeaters? Some are owned by individuals, but most are run by ham clubs. There are few areas in the United States without at least one repeater, and most towns have several. The **ARRL** publishes a directory listing them all in a thick little book.

Since a repeater transmits and receives at the same time, it must, of course, use different frequencies for the two functions or it would receive its own signal and quickly go to feedback heaven. The difference between the transmit and receive frequencies is called the **offset** or *shift*. Most repeaters on the 2 meter band use a 600 kilohertz offset, while those on the UHF bands use a 5 megahertz offset. On the 1¼ meter (220–225 MHz) band, the offset is 1600 kHz (1.6 MHz).

The transmit frequency may be higher or lower than the receive frequency. A **band plan** specifies **frequency pairs**, and few repeaters deviate from it. The HT, of course, transmits and receives on the same frequencies, but in reverse. Thus the handheld's transmit frequency is the same as the repeater's receive frequency, and vice versa.

Some repeaters provide functions beyond simple retransmission. One of the most popular extras is the autopatch, which allows connection to the landline telephone network. With it, you can make phone calls from any walkie equipped with a DTMF pad. Observation of the rule prohibiting business-oriented transmissions is especially important when using the autopatch. Other functions include voice-synthesized time, date, and signal reports, and even the ability to link multiple repeaters into a network permitting communication over hundreds of miles. Imagine using your handheld to talk with someone three states away while you walk down the street!

Miss Manners

Operating through a repeater requires etiquette altogether different from that used on the HF bands. Instead of calling **CQ**, you say "(your call) listening." Signal reports are given in terms of **quieting**, rather than strength; it's impossible to know the originating station's strength into the repeater because you are listening to the retransmitted signal. A report of "full quieting" means you are coming through with no background hiss, while one of "70 percent quieting" means your signal into the repeater is scratchy.

Because only one station can use the repeater at a time, it is considered very discourteous to tie it up with long monologues. Short, succinct transmissions keep the conversations flowing smoothly and promote acceptance and friendliness toward new users.

Getting Out

HTs are designed to be used on the go, so get out there and have fun. Bring yours along when camping, hiking, walking, or even shopping. And of course, what ham would be caught dead at a hamfest without his trusty walkie?

...Michael Jay Geier KB1UM

Glossary

ARRL The American Radio Relay League.

Autopatch A repeater function that permits connection to the landline telephone network.

Band plan A gentlemen's agreement regarding usage of frequencies within the band.

CTCSS Continuous Tone Coded Squelch System. *PL™*, "private line," is Motorola's trademark for CTCSS. Some repeaters use these tones to avoid reception and retransmission of unwanted signals.

CQ ("Seek-you") A CW abbreviation meaning "calling any station."

Digital memories Storage registers in HTs, used to hold frequencies and other operating data, such as offset.

DTMF Dual Tone Multi Frequency. The generic term for the tones produced by a Touch-Tone™ phone. Used for autopatch and repeater control.

FM Frequency modulation. Nearly all walkies, repeaters, and mobile rigs are FM. An FM receiver isn't sensitive to amplitude variations caused by impulse-type noise or fading signals.

Frequency pair The transmit and receive frequencies used by a repeater.

Helically wound Wound in a spiral shape, like the wire in a rubber duck antenna.

Offset The difference between the transmit and receive frequencies, also known as the *shift*.

Quieting The degree to which a received FM signal overcomes the background noise. A full quieting signal is the best possible signal.

Repeater Automated station which simultaneously retransmits signals on a frequency different from the frequency on which they were received.

RF energy Radio frequency energy. The radio wave spectrum begins at 20,000 Hz (cycles per second) and extends to beyond 300 billion Hz.

Rubber duck A flexible rubber-encased antenna with internal helically wound wire.

Simplex Receive and transmit on the same frequency.

UHF Ultra High Frequency. The UHF spectrum ranges from 300 to 3000 MHz. Amateur UHF bands are the 70cm (420–450 MHz), 33cm (902–928 MHz), and 23cm (1240–1300 MHz). 23cm is often considered a microwave band.

VHF Very High Frequency. The VHF spectrum ranges from 30 to 300 MHz. Amateur VHF bands are the 6 meter band (50–54 MHz), the 2 meter (144–148 MHz), and the 1¼ meter (220–225 MHz) bands.

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Contract: Just by reading this, you have entered into a binding legal contract. To avoid being prosecuted under every penalty provided by law, you will spend a minimum of two hours per week on ten meters talking with Novices and encouraging them. No excuses will be accepted. No exceptions. Ask questions—get them to talk—make hamming fun for them. Keep notes—a report will be required.

73 AMATEUR RADIO

DECEMBER 1989 Issue # 351

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FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

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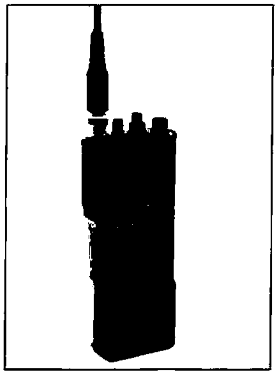
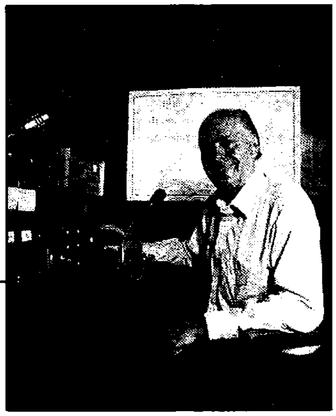


See page 18 for more on this little wonder.

Number 2 on your Feedback card



NEVER SAY DIE

Wayne Green W2NSD/1

How You Can Help Save Amateur Radio!

Here comes that confounded Gloom & Doom Wayne Green again. Sigh. Naw, au contraire, I cometh with solutions, not problems. Good solutions, too. Maybe even fun solutions.

I've always remembered the sign on the Director's door at a research institute where I studied forty years ago. It said, "Bring me solutions, not problems." Chap named L. Ron Hubbard—maybe you've read about him—made billions. It's a good concept.

Alas, before we plunge into the solutions, I should at least give some hints as to the problems. The bottom line problem is that we've had pitiful little growth in the last 25 years and, so far, no visible prospects for much more. We're watching our fellow old timers running our ham clubs and tottering around with their walkers at hamfests, muttering to themselves.

I've heard all the rationalizations (which I'm sure you passionately believe) for why we aren't attracting youngsters any more. It's the code. Kids have too many other interests today. They're too lazy. They're all into computers. Yep, all those things are true, but they're just excuses, they're really not the main problem.

W6NKE, in a letter in the *QCWA Journal*, said it. If we want to attract youngsters (or anyone, for that matter), hamming has to be fun. One only has to listen to the bands today to realize that operating isn't much fun anymore. Between DX pileups, where we have massive proof that intentional interference is alive and well, DX jamming, net jamming, repeater jamming and language which wouldn't even have been considered possible 25 years ago, if you want to interest someone in amateur radio you'd better not let them listen to our bands.

It won't be easy, but I believe we can fix the mess we've allowed to happen. As a matter of fact, it'll be fun fixing it. I think we can clean it all up—yes, even the DX pileups.

Okay, let's suppose we're actually able to clean up the garbage on our bands. Then where are we? Then we're left with the same old banal signal report contacts which have been amateur radio's quagmire ever since the hobby started. No, we've not only got to clean up our garbage, we're going to have to do it ourselves, without asking or expecting any help from the FCC, the ARRL or any other bureaucrats, and then we're going to have to set about making ham contacts actually interesting. Wow, what a concept! I believe we can do all this—and it'll be fun. You'll see. Now stop being a curmudgeon and see what I'm going to propose. Yes, I already can hear the whining arguments that it won't work. Baloney.

A couple years ago the gullible were convinced that the Novice Enhancement program was going to save amateur radio. Spoilsport Green said no, it won't. Now it's the no-code malarky. I don't care whether you are in favor of a no-code license or not, the present ARRL proposition is a hoax. It's a safe way to be in "favor" of no-code, all the while burning it at the stake. All the fire and fury will distract the membership from actually thinking, seems to be the theory. Good theory.

As I pointed out in my recent talk at the Huntsville hamfest, no-code today is a religious matter. It's something about which you have no facts, and that you believe in passionately. That's religion and we kill people who disagree with us on religious matters. Oddly enough, we don't seem as anxious to kill people over facts.

The proposed no-code salvation for American amateur radio meets the requirements for being a duck. It looks like the Canadian no-code license, smells like it, walks like it, sounds like it. . . by golly, it *is* a duck! The Canadians, for those of you who have been

continued on p. 82

CQ's Dastardly Attack on the ARRL

The amateur radio community was shaken to its foundations by the recent vicious and unprovoked attack by *CQ Magazine* (October 1989) against the ARRL. Tsk.

The *CQ* editorial took The League to task for wasting some $600,000 or so on their new W1AW hamshack. Worse, instead of using ham gear, which they probably could have had for free, they spent top dollar buying commercial communications equipment.

What do we have to do, form a committee to stop these political attacks on The League? Obviously the *CQ* editors, motivated by greed, are trying to destroy our beloved ARRL. As an ARRL member with a 50-year pin proving beyond any question my total devotion to this great organization, perhaps I should head such a committee. Do I hear from any volunteers to start local chapters?

In the meanwhile I hope you will flood the *CQ* editors with letters expressing your revulsion and disgust at their sorry, bumbling attempt at sowing discord and distrust among true-blue ARRL stalwarts.

Heck, I say that if The League's directors don't think the Kenwood, ICOM, Yaesu and Ten-Tec gear is good enough for their paid commercial ham operators to use, I think we should respect their decision. Who would possibly know better than the ARRL and *QST* what equipment is best for a top-notch ham station?

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QRX . . .

Smile for the Camera!

Have any color ham radio related photos—ham clubs, humor, etc.? Give'em world-wide exposure in the QRX column, one of *73*'s hottest departments. Any reasonable submissions stand a good chance of appearing here in the near future. No polaroids, please; we need prints from 35mm or better film. Make sure to send them to the attention of QRX.

Ham License Fees

The US House of Representatives passed and sent on to the Senate the 1989 federal deficit reduction bill that includes a $30 fee for amateur radio licenses. The Senate is expected to act quickly on the measure and then send it along to President George Bush for his signature. Stay tuned for a full report.

UK Novice

The Radio Society of Great Britain (RSGB) proposed a pair of new entry level Novice class licenses for the UK. "Novice B" would be a code-free certificate with VHF voice privileges above 30 MHz. Passing a five wpm code test, to receive the "Novice A" ticket, adds phone privileges on 160 meters.

If the British Department of Trade and Industry gives its nod to the RSGB proposal, the applicant will have to take a 30-hour training course, given by a DTI-approved instructor. The RSGB says this would replace the Morse code test as a method of assuring the proper standards in the British Amateur Service. These licensees would be granted many emission modes applicable to the bands and band segments assigned to the current license class, but at a maximum power of only five watts. There would be no minimum age to gel either ticket and both would carry a three-year renewable license term.

The RSGB says this proposal is based on a survey of its members up to age 25. They add that a Novice ticket is needed to help offset the severe shortage of skilled electronics technicians and engineers in the UK. The UK has a no-code license, but it requires an extremely high level of skill to obtain.

If the DTI approves the RSGB Novice proposal, the UK will be second only to Japan in its liberalization of amateur licensing using no-code as an entry point.

PRB-1 Wins in Costa Mesa

Hams in this California city have something to cheer about: a new antenna ordinance that gives them a lot more then they expected.

For many years, the Costa Mesa city government told permission-seeking hams to put up whatever system they wanted. Several years ago, however, the city suddenly enacted a 30' maximum height ordinance. When the city decided that it was time to change the variance requirement, Fried Heyn WA6WZO appointed Art Goddard W6XD to promote a drive for a less restrictive ordinance. Goddard organized a mass turnout of hams to a Costa Mesa City Council meeting that lasted until 2 a.m. That motion was passed, and the Council also enacted a second motion that held off enforcement of any antenna ordinances against hams until there was one mutually agreed-upon by the City and the resident amateurs.

Heyn supplied to the Council, in September '88, PRB-1 material from attorney Wayne Overbeck N6NB and an emergency communications news story about Costa Mesa resident Gordon West WB6NOA. This led to a second City Council meeting. The Costa Mesa City Attorney felt that the terms of PRB-1 took precedence over anything the city might want. As a result, Costa Mesa agreed that its current ordinance was not within federal pre-emption guidelines. Heyn, Overbeck and Goddard met with local hams and city planners to work up an ordinance acceptable to both.

In mid-August, that proposal went before the City Council which passed it with little discussion. It calls for a maximum antenna height without variance of seven feet, grandfathering of all existing towers and antennas as long as they are registered with the city before May 1990 and exclusion of any antenna weighing 80 pounds or less. The city even took the unusual step of writing to each ham living in Costa Mesa detailing the new and more liberal ordinance!

Pirate Taxi Dispatches

The New York City FCC office asks the help of area hams to rid the 10m amateur band of illegal taxicab dispatch services. Hams in the Northeast have been outraged by the indifference of the NYC FCC office to this problem. The illegals even threatened one ham's life.

Kevin McKeon, Engineer in charge of the NYC Field Operations Bureau, inspected many cabs in May and June, which led to the closing down of some illegal dispatch stations. The problem is far from licked, though, and the FCC asks for your help. If you have any info on the illegal operators' identities, their hours of operation, their locations, addresses and/or vehicle license numbers, please send it to the **NYC FCC, 201 Varick Street, New York, NY, 10014.**

Harrison Indicted

An Oceanside, New York ham faces a possible maximum sentence of 250 years in jail and 12.5 million dollar fine if convicted on all 50 counts of alleged mail fraud. Michael D. Harrison WB2PTI was indicted by a Grand Jury of the US District Court on charges of mail fraud. The indictment states Harrison placed full-page ads in amateur radio journals claiming that the long defunct Atlas Electronics had joined forces with Uniden to bring out the very popular HR-2510 10m mobile rig. The ad indicated that Atlas operated out of a post office box in Lynbrook, New York and offered the transceiver for only $220. The government says that Harrison never delivered the promised radios even though he received a substantial number of prepaid orders, including one for over $3,000. On 26 January, Harrison was arrested and charged with mail fraud. He was released after posting a $25,000 bond. No trial date has yet been set and prosecutors say that the full dollar amount of the alleged swindle may never be known.

Court Appeal to Save 220–222 MHz

The ARRL went to court to stop the reallocation of the lower 40% of the 1¼m band to commercial service. League Counsel Chris Imlay N3AKD filed the petition to review the FCC reallocation order, in joint cooperation with a second Washington law firm that specializes in these matters. The petition demands that the US Court of Appeals for Washington DC set aside the reallocation of 220–222 MHz over to Land Mobile services and then to remand the matter to the FCC for re-disposition. In its filing, the League claims the reallocation action was arbitrary, capricious, and an abuse of discretion. Case number 89-1602 has been assigned by the court.

Ham Wins Grammy

The National Academy of Recording Artists and Sciences recently honored Larnell "Stu" Harris WD4LZC, of Louisville, Kentucky, for the best male performance by a gospel singer. Harris received his award at the 31st annual Grammy Awards Ceremony in Los Angeles.

Big Thanks

. . . to *Westlink Report*, David Black KB4KCH, and Roy Neal K6DUE, for furnishing this month's news items. Keep your ham radio-related news items and photos rolling in to *73 Magazine*, WGE Center, Forest Rd., Hancock NH 03449, Attn: QRX. You may also submit text as E-Mail to the Sysop on the the 73 BBS, (603) 525-4438, 300/1200 baud, 8 data bits, no parity, and one stop bit.

VOX for HTs

VOX circuit for the IC-2AT and other HTs.

by Thomas E. Warfel KA8HML

The classic ICOM 2AT is the "VW bug" of amateur radio: It's reasonably priced, rugged, and reliable. Unfortunately, there have been no commercial VOX units for it. This article presents a small, low-power VOX circuit for an ICOM 2AT, or just about any other handie-talkie, which you can build using standard surface-mount components.

Circuit Overview

To minimize power consumption, I used a Texas Instruments TLC1079 IC, a quad low-power, low-voltage op amp. Each op amp forms the core of one of four sub-circuits that together make up the VOX. One acts as a buffer to reduce the combined load of the VOX and radio on the microphone, while the other three form the actual voice-detect/switching circuit. See Figure 1.

IC-1B isolates the microphone from the radio. This way, when the transmitter engages, it doesn't change the load at the audio input to the VOX. Note that C4 acts to remove the DC bias from the output signal being fed to the radio. This is important because, while the AC component carries the audio, it is the DC component (switched by Q1) that actually switches the transmitter on and off.

The remaining three op-amps are used only to detect the presence of speech, not to pass speech faithfully. The first VOX stage is an audio filter designed to pass frequencies from about 100 Hz to 800 Hz while providing a net gain of around 50. This is adequate to amplify speech while reducing the likelihood of picking up stray audio noise.

The second VOX stage is little more than a comparator. When the incoming signal (the sum of the DC virtual ground plus the AC amplified/filtered audio signal) exceeds the DC threshold set by R10, R12, and R13, the output of IC-1D goes high. This threshold level, the VOX sensitivity, is adjusted by potentiometer R12 and stabilized by C10. Not all speech sounds will be loud enough to exceed the threshold; maybe only twenty percent or so will cause triggering.

The third VOX stage is needed to "prolong" the pulses from the second VOX stage so that the transmitter stays on, rather than just pulsing on and off. R16 adjusts how long the VOX stays on per triggering. The ICOM 2AT is keyed by pulling the microphone line low through Q1.

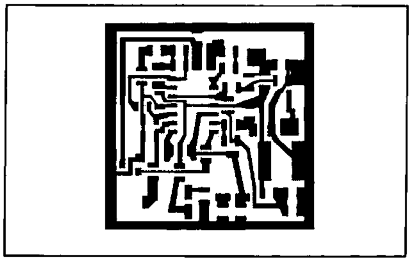

Figure 1. 1:1 printed circuit board etch-resist pattern.

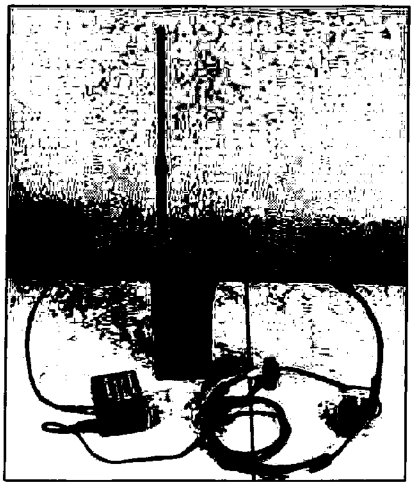

Photo A. How the author mounted the VOX with switch and battery. The "belt clip" is formed from two press-on cable guides.

Constructing the Circuit

The IC is a static-sensitive device, so use a grounded iron if possible. Since the components are small and the circuit traces even smaller, a low-wattage iron generates more than enough heat for these purposes. Unless it's temperature-regulated, anything over 30 watts is likely to lift traces off the circuit board.

Most of the challenge of building with surface mount components is putting the devices where you want them. You *will* need a free-standing magnifying glass (or some other kind of hands-free magnifier), clean tweezers, small diameter rosin core solder, and thin "unsoldering" copper braid. Avoid vacuum-type desoldering tools; they tend to suck up components as well as solder. Taping down the corners of the circuit board makes soldering much easier.

Solder the parts directly; don't glue them down first. Tin the copper foil pads, gently position the component on the board with your tweezers in one hand, and touch the tip of the iron to the pad with your other hand. When soldering the IC, use as little heat (and solder) as possible, and wait at least ten to twenty seconds between soldering each pin. The "D" SOIC (Small Outline Integrated Circuit) package is smaller than a normal IC, so the heat dissipation is less than a normal IC as well.

Assembling the Circuit

Go slow when soldering the parts on the board. It takes me about three hours to assemble one board; allow twice as much time if you're new to surface-mount technique. Refer to Figure 3 for parts placement.

Follow this sequence for smooth assembly:

1. Install the two jumpers J1 and J2.
2. C1, C12, C16 (100 pF). Make sure C16 is not bridging any adjacent circuit traces.
3. C15 (1000 pF).
4. C2, C4, C6 (0.1 µF).
5. C3, C13 (220 pF).
6. R1 (5.6k); R4, R5 (100k); R6, R14 (1 M).
7. Diode D1—use voltmeter to verify device polarity!
8. C5 (10 µF to 30 µF). Note that the end with the white band is toward the center of the board, not the edge.
9. R2 (1k); R3 (2.2k).
10. If you haven't done so yet, take a break!
11. R15 (1 M); C11 (.47 µF)—white band points inward; R10 (2.2 M); R17 (100k).

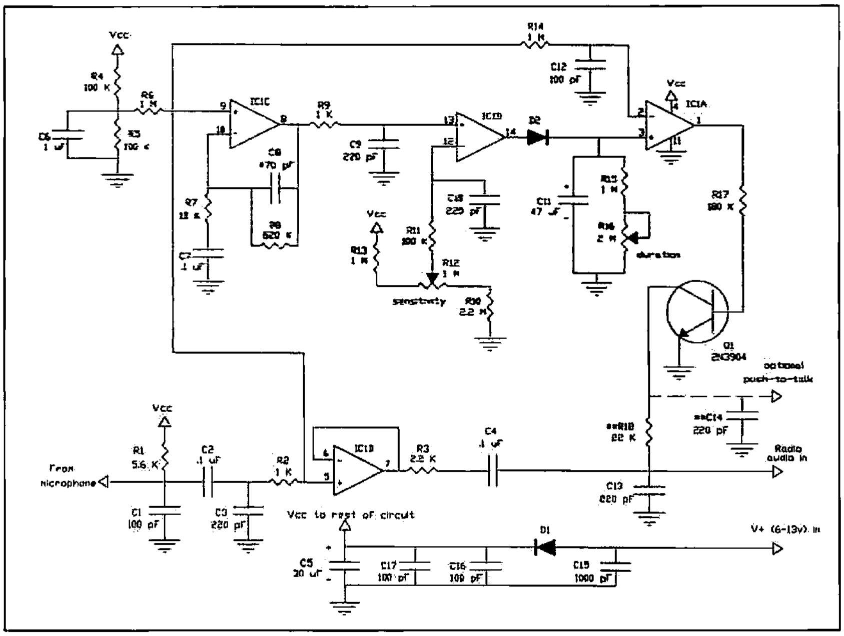

Figure 2. Schematic for the VOX unit.

12. R16 (2 M potentiometer).
13. IC-1. Note that one side of the IC is beveled. That side should face the half of the board just completed.
14. R13 (1 M); R11 (100k).
15. R12 (1 M potentiometer).
16. Deflux the board now if you have flux remover. Don't scrub with a wire brush, just rinse the board with solvent.
17. Diode D2. Again, be sure of your polarity.
18. C17 (100 pf). This is probably the most difficult component to install without shorting adjacent traces.
19. Take another break.
20. C10, C9 (220 pF).
21. Q1.
22. R9 (1k), C7 (0.1 µF).
23. R8 (820k), C8 (470 pF), R7 (10k).

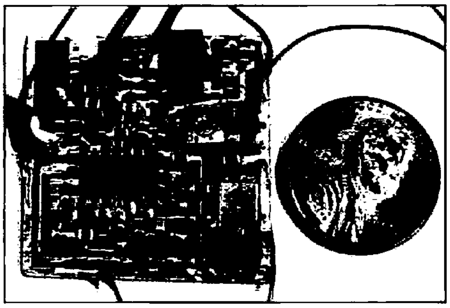

Photo B. The VOX unit measures only 1.2" x 1.0" x 0.2".

If you are assembling this to use with an ICOM 2AT or a similar rig in which the microphone line doubles as a push-to-talk (PTT) line, install R18 (22k), deflux the board, and go to the testing section.

If you are assembling this to use with a rig that requires a separate PTT line, do NOT install R18. Instead, install C14 (220 pF), deflux the board, and go to the testing section.

If you need to drive a relay with this circuit, install C14. Connect one side of the relay coil to the "optional-push-to-talk" pad, the other to the V+ pad. Connect a 1N914 diode across the relay coil, as shown in Figure 4. Deflux the board.

Circuit Testing

1. Tack-solder a 9V snap-type battery clip to the board with the positive (red) lead going to the V+ pad and the negative (black) lead going to the ground pad. Connect one terminal of a 9 volt battery to one of the snap buttons, but leave the second terminal unconnected. You will probably have to rotate the battery around the first snap to do this. With a milliammeter, complete the circuit between the free battery terminal and snap-on clip. The circuit should read between 50 and 100 microamps (0.05 mA to 0.1 mA). If the current reads less than this (or even zero), check to make sure that the battery is good, that there is battery voltage between the V+ pad and the ground pad (faulty battery clip), or whether D1 is in backwards. If the current reads much more than this, see if C17 is shorting the power lines, or if C5 and/or C11 are wired in backwards.
2. Assuming correct current, fully connect the battery terminal to the clip. Measure the voltage between ground and the junction of R4, R5, and C6. It should be between 3 and 5 volts. If lower, check to make sure the battery is good, and that D1 and C5 are well-soldered and making good electrical connections. Also see if either R5 or C6 are shorting the pad to ground. If the voltage is greater than 5 volts, check to see if resistor R6 is shorting out on the Vcc trace, or if R4 is shorted out.
3. Assuming that the R4, R5, and C6 junction pad voltage was acceptable, turn potentiometer R12 completely counter-clockwise. Measure the voltage on IC-1 pin 14 relative to ground. It should be at or near 0 volts. If the voltage, however, is at or near Vcc, measure the voltage at pin 13. If pin 13 is at 0 volts, check R13, R12, and R11.
4. Assuming pin 14 checked out, turn R12 completely counter-clockwise. Check the voltage on pin 14 again; if it is now at Vcc, back R12 clockwise again until the voltage on pin 14 goes back to zero. Disconnect the battery, and tack-solder microphone leads between the "to headset microphone" pad and ground. Lead polarity is important.
5. Reconnect the battery to just one snap, and measure the current as in step 2. It should now be between 0.3 mA and 0.5 mA.

   If the current is lower than this, check to make sure the microphone leads are correctly connected, and that R1 is properly installed.
6. Assuming proper circuit current, fully connect the battery. With a voltmeter, measure the voltage on pin 14. If it is above Vcc/2, quietly turn R12 clockwise until it goes back to zero.
7. Tap the microphone. With each tap, the voltage on pin 14 should briefly spike up to Vcc. If there is no change at pin 14, test with a small amplifier/speaker in series with a 100 µF capacitor as follows: Connect the capacitor negative lead to circuit ground. Connect the capacitor positive lead to one of the amplifier leads. Connect the other amplifier lead to IC-1 pin 8. Tap the microphone. If you don't hear any noise from the speaker, there is a problem with the circuitry for op amp IC-1C. If you do hear noise, check the circuitry for op amp IC-1D.
8. Assuming pin 14 is responding correctly, connect the voltmeter between pin 3 and ground. Again, tap the microphone. With each tap, the voltage should spike up to at least Vcc/2, then slowly decay back to 0. If there is no spike, check the polarity of diode D2.
9. Rotate R16 completely counter-clockwise. Connect the voltmeter between pin 1 of IC-1 and ground. Tap the microphone. With each tap, the voltage should briefly spike. Rotate R16 completely clockwise. Tap the microphone. The voltage should spike, but then stay high for a moment before dropping. If the voltage at pin 1 is always high, check to see if C12 may be shorting pin 2 to ground. If the voltage is zero, check to see if C11 and R14 are correctly installed.
10. Rotate R16 completely counter-clockwise. Speak into the microphone. Adjust R12 so that pin 1 bounces high when you speak in a moderately loud voice but does not go high when you breathe. Once R12 is adjusted, starting speaking continuous-

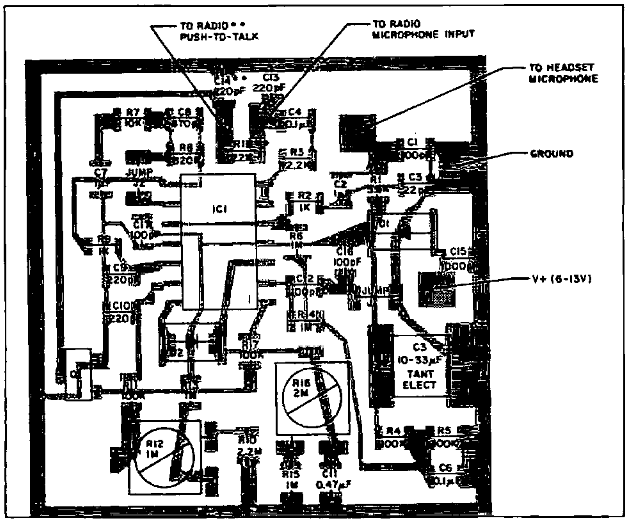

Figure 3. Parts placement diagram.

Parts List for the 2M VOX

Component	Value	Supplier/Part ID	Each	Total
R2, R9	1k	Garrett MCR10JW102	0.14	0.28
R3	2.2k	Garrett MCR10JW222	0.14	0.14
R1	5.6k	Garrett MCR10JW562	0.14	0.14
R7	10k	Garrett MCR10JW103	0.14	0.14
R18	22k	Garrett MCR10JW223	0.14	0.14
R4,R5,R11,R17	100k	Garrett MCR10JW104	0.14	0.56
R8	820k	Garrett MCR10JW824	0.14	0.56
R6,R13,R14,R15	1 M	Garrett MCR10JW105	0.14	0.56
R12	1 M pot.	Garrett G4E105M	1.98	1.98
R16	2 M pot.	Garrett G4E205M	1.98	1.98
R10	2.2 M	Garrett MCR10JW225	0.14	0.14
J1,J2	0Ω	Garrett MCR18JW000	0.08	0.16
C1,C12,C16,C17	100 pF	Garrett 0805N101J101	0.28	1.12
C3,C4,C10,C13,C14	220 pF	Garrett 0805N221J101	0.30	1.50
C8	470 pF	Garrett 0805N471J101	0.30	0.30
C15	1000 pF	Garrett 0805N102J101	0.35	0.35
C21,C4,C6, C7	0.1 µF	Garrett 08052104M500	0.25	1.00
C11	0.47 µF	Garrett 1812B474K500	1.25	1.25
C5	33 µF	Garrett 267M1602336M	1.68	1.68
Q1	2N3904	Garrett MMST3904	0.30	0.30
D1,D2	1N4148	Garrett RLS4148	0.15	0.30
IC-1	TLC1079ID	Marshall Industries	7.25	7.25
DP3T	momentary	Augat Alcoswitch CST-023TA	2.50	
PC board, battery clip, mounting case, headset jack, radio plugs, wire				12.00

Parts Suppliers

Garrett IEU, Inc.
3130 Skyway Dr., #104
Santa Maria CA 93455
(805) 922-0594

Marshall Industries
in Pittsburgh PA
(412) 788-0441

Augat/Alcoswitch
(call for local distributor)
1551 Osgood Street
North Andover MA 01845
(508) 685-4371

Meadowlake Corporation
PO Box 497
Northport NY 11768

ly. Slowly rotate R16 clockwise until the pin 1 stops bouncing and just stays high. Stop speaking and verify that pin 1 goes low again. The VOX circuit assembly is now complete.

Installation and Use

There are times when a headset/PTT arrangement may be more appropriate than VOX. I wired my VOX unit with a 3-way toggle switch, an Augat Alcoswitch CST-023TA, to easily switch between the two. Center is off, one side is momentary PTT, and the other side is VOX.

I used a DP3T instead of a DPDT-center off to avoid keying the transmitter when turning the VOX off. Merely turning off circuit power essentially turns the microphone off. This generates electrical noise which is picked up by the VOX as if it were a sound spoken by a person. As the circuit consumes so little power, the residual charge left on C5 (the despiking capacitor) can easily switch the transmitter on for a moment. Ideally, one would solve this problem by using a resistor/capacitor combination to buffer microphone power separately from circuit power. In this way microphone power would stay on just a bit longer than circuit power when the unit is turned off, thereby avoiding the "noise." Unfortunately, this would require around a 220 µF capacitor, which is larger than the rest of the circuit! With a DP3T switch, you can instantly quiet the circuit by draining C5 as soon as you disconnect power. See Figure 5 for details.

I mounted the entire assembly (VOX, switch, 9 volt alkaline battery, jack for the HS-10 headset) in a 3.75" x 1.25" x 2" blue plastic Unibox and added a belt-clip. The circuit itself takes very little space; it's the battery, wires, switch, and headphone jack that take up the room.

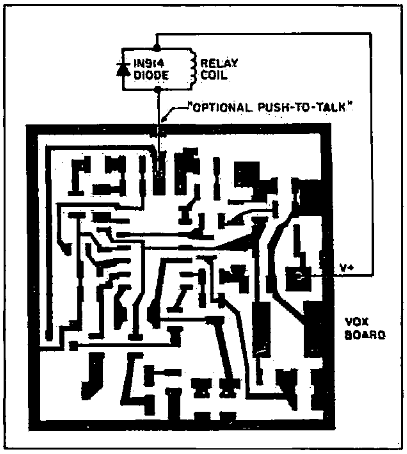

Figure 4. Connecting a relay to the VOX board.

Other Radios

You can use this same VOX circuit with other handi-talkies with only minor alterations. Yaesu HTs have the same type of PTT detections as the ICOM and can work unmodified.

Kenwood HTs have a slightly different means of detecting a PTT condition with their external microphone. To use this circuit with a Kenwood HT, install VOX component C14 instead of R18, and then wire the "To-radio-push-to-talk" pad to the Kenwood PTT line (microphone jack "ground") and the "to-radio-microphone-input" pad to the radio microphone-input line. The VOX circuit ground must then connect to the external speaker ack ground (and not to the external microphone jack "ground" connector).

Conclusion

The final circuit is roughly 1.2" by 1" wide, draws less than 0.5 mA, and is relatively resistant to ambient RF. Total cost of parts and mounting, excluding the headset, is around $40. Circuit boards and parts kits are available through the Carnegie-Mellon Amateur Radio Club. Send an SASE to Tom Warfel, CMUARC, 414 South Craig St. #176, Pittsburgh PA 15213.

Thomas E. Warfel, licensed as a Novice in the late '70s, currently holds an Advanced license. He graduated cum laude in Electrical Engineering in 1988, and is now in his second year as a medical student. His address is 120 Ruskin Ave., #603, Pittsburgh PA 15213.

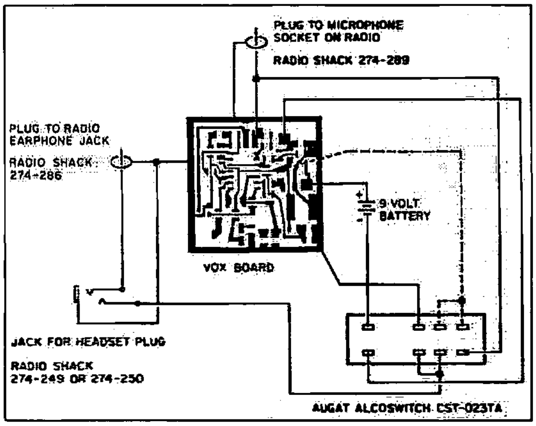

Figure 5. Putting it all together. This shows how I wired my VOX to my ICOM 2AT so that by throwing the switch in one direction, I had VOX, center was off, and the other direction was a momentary PTT.

HAM PROFILES

There are no "average" hams!

Linda Reneau KA1UKM. Linda is 73 Magazine's *Senior Editor.*

Nurse, Author, Poet, Ham

Linda Reneau KA1UKM has been an editor at *73 Magazine* for two years. Last summer she got her Novice license and continues to study for an upgrade. As an adolescent, she was an SWLer and science fiction fan. She belonged to the Astronomy Club of Kansas City, Junior NASA, and the Civil Air Patrol. One of her goals is to start a dream discussion net.

At present, she reads about two SF books a week and is active in astronomy. For physics, she reads Fred Wolf's intriguing books. She's lived in Louisiana, Missouri, New York City, Arizona, Alaska, California, and now New Hampshire. Besides writing and editing, she's worked as a nurse, firefighter, and bookkeeper, among other things.

Recently she completed a book, *A Manual of Dream Art/Science. To the Sky,* a book of poetry, was published in 1984 by Orca Press in Alaska. Other poems have been published in anthologies, and many articles on dream studies have been published in *The Dream Network Bulletin*. She is currently working on a new book, *Dreaming for Spiritual Growth.*

"Da Schmooze"

Jim Bail KA1TGA is a ham with many interests and talents. He was once an aspiring college and semi-pro baseball player. Before graduating from college, he travelled to Germany to open a white-water rafting program for the AFRC (Armed Forces Recreation Command) and in his spare time was a mountain climbing guide in the Bavarian Alps. After teaching environmetal education at an outdoor education school in Trinity, Texas, he spent a season as mainsail driver on an ocean racing yacht.

Jim Bail KA1TGA. Jim is a member of the 73 Magazine *advertising sales team.*

His first job in the communications field was as "Sky Watch One," an airborne traffic reporter for KTRH newsradio in Houston, Texas. He then moved to WKBK radio in Keene, New Hampshire, where he was News Director and hosted a talk show where he interviewed presidential candidates during the 1988 campaign. He has worked for *73 Magazine* for two years and is now an advertising sales representative.

Jim is a community volunteer for the Contoocook Valley (NH) High School's solar racing car and Amateur Radio Club and a member of the Board of Directors of the Red Cross. He will also coach an area Babe Ruth baseball team where he hopes to have a winning season AND to expose his team to the excitement of amateur radio.

Jim is not the only ham in his family. His late grandfather W8BWD, his father NV3J, and his brother N8KIR share and pass on their enthusiasm for the hobby. 73

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Number 6 on your Feedback card

73 Review *by Michael Jay Geier KB1UM*

Yaesu FT-470 2m/70cm HT

Yaesu USA
17210 Edwards Road
Cerritos CA 90701
Tel. (800) 999-2070;
(213) 404-2700.
Price Class: $500

Dual-band fun in an HT only slightly larger than the FT-411.

Yaesu introduced the first dual-band walkie a few years ago. The FT-727R, though somewhat large and power-hungry, was an instant success, and many are on the air today. Recently, miniature dual-banders have begun to appear, and Yaesu is once again at the forefront of the technology with the introduction of the FT-470.

Resembles FT-411

The 144/440 MHz FT-470 is patterned after the highly successful FT-411 series of single-band walkies, and it's impossible not to compare the two rigs. The '470 has the same basic look, a very similar keypad function layout, and a slightly longer and thicker case. It uses the same batteries, mikes, and most of the other accessories.

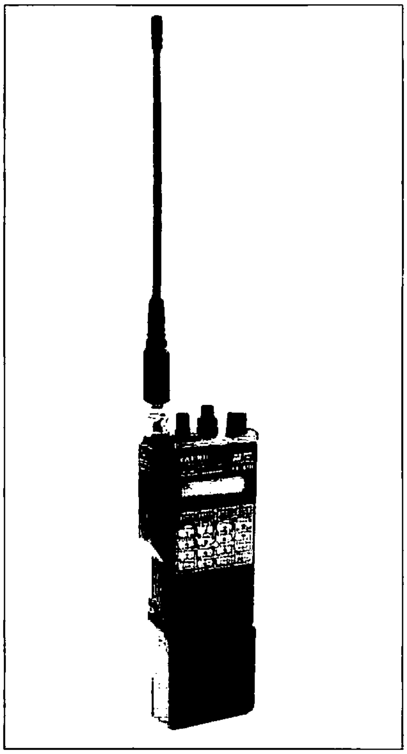
Small, Powerful Battery

The battery was the first thing I noticed when I opened the box. It was about ½-inch shorter than the FNB-10 which was shipped with my '411. A glance at the back, however, revealed that it had the same 7.2-volt, 600 mA-hour capacity. As it turns out, it even uses the same charger! There is no electrical difference between the two packs. I immediately ordered one for my '411, and I love it; now the rig is truly pocket-sized, with no compromise in performance. If you want to get one, the battery's model number is FNB-17.

The FT-470 is small as dual-banders go. It's about one inch longer than the '411. The supplied YHA-28 duck is actually longer than the radio! By the way, the duck is flexible and appears very well made. The rig fits comfortably in my hand, and the keys are larger and easier to press than those on the '411.

Simultaneous Monitoring

The top of the radio has four controls: squelch (which operates on both bands simultaneously), volume, balance (concentric with the volume control), and the "dial" knob. The balance control adjusts the relative volumes of the two bands. That's right, you can monitor both bands at once! Also on top are the mike and earphone jacks and, of course, the antenna connector.



The Yaesu FT-470 dual-band HT.

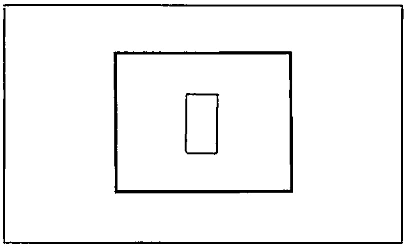


Figure 1. The Kaboom Audio Enhancer for the FT-411 (June '89) works equally well for the FT-470.

The left side houses the rubber buttons for the PTT, squelch monitor, and lamp. As for the '411, the lamp lights the keypad as well as the LCD. I find this very handy for night operation.

All other functions are performed from the keypad. In addition to the usual sixteen keys, there are four more, permitting you to do some commonly-used operations without pressing the FUNCTION button. This arrangement is especially nice for the REVERSE function, which requires only one keypress, instead of the two used on the '411.

Another improvement is the separation of the keypad lock and PTT lock into two keys. Now you can lock the PTT without locking the pad.

The LCD is large and easy to read. The numbers and icons are clearer than the '411's. Both the main band and subband are shown, with the main band's frequency on the left in large numbers, and the subband's on the right, in smaller numbers.

Yaesu opted for a 5½-digit display. The half digit refers to the kHz display. Rather than a zero or a five, there is just nothing for a zero, and a small block which shows "50" for a five. This is somewhat disconcerting when entering frequencies from the keypad, because the display looks the same (for frequencies ending in a zero) before and after you've entered the last digit. Actually, the decimal point only comes on when you finish the entry, but it's easy to overlook. Several times I was unsure whether or not I had entered all the digits. There seems to be no advantage to this kind of display.

The FT-470 includes nearly all the features of the '411. The only thing missing is the VOX circuit, which few of us are likely to use, anyway. Of course, there are new features related to dual-band operation. The BAND key transposes the main and subbands. The SUB key turns the subband on and off. The ALT key allows the rig to alternate between bands during memory scanning.

Memory Functions

The rig has two memory banks, one for each band. Each bank contains 20 memories, any of which can hold odd splits, and the frequency and status of the included CTCSS encoder/

decoder. Two memories in each bank set upper and lower scan limits. Memories may be locked out from scanning, or hidden entirely.

Each band also has a "call" memory, accessible from the CALL key. This memory is just like the others, except that it doesn't get scanned, and you can access it with one keypress. It's especially handy for simplex and hamfest use. It shares one quirk with the '411: If you turn the dial on top of the radio while you are using the call memory, it transfers the frequency to the VFO, trashing whatever was there. The regular memories don't do that.

There are two VFOs for each band, for a total of four! That's a lotta VFOs. Of course, you can never be too rich, too thin, or have too many VFOs, and in a pinch, you can use them like extra memories.

As on the FT-411, memory management is very flexible. Memories can be fixed or tunable, and you can perform various kinds of scanning and priority operations. But this radio can do all of it on two bands at once! You can be memory scanning on 2 meters while band scanning with sequential priority watch on 440! It may sound confusing, but it's easy to do. A multitasking microprocessor with the usual lithium battery backup makes it all possible.

The DTMF pad has a ten-number autodialer. The '411 also has this feature, and I have grown to love it. If you're in walkie range of the repeater, you'll find yourself using it to dial friends while you drive, instead of trying to manually key the autopatch codes and phone number into your mobile rig.

Radio Performance

The receiver and transmitter operate well. The receiver seems considerably more sensitive on VHF than the '411's, especially for public service band scanning. The NOAA weather channel, which is fairly weak on my '411, is full quieting and nearly full scale on the '470's LCD S-meter.

There isn't much 440 activity here in northwestern Vermont, so it is hard to check sensitivity on that band. The local repeater, however, comes in fine. The transmitter sounds crisp on the air. With the supplied battery, it puts out 2.3 watts on both bands. At 12 volts, you get 5 watts. A "low" position cuts the output down to much less, saving battery power. Interestingly, the high/low setting is specific to each band. For instance, you can be set for high on 2 meters and low on 440, or any other combination you desire.

The FT-470 can operate full duplex because it continues to receive on the subband even while transmitting on the main band. Hearing the receiver come to life while you're transmitting is an eerie experience that takes some getting used to. If you add a connection from the earphone jack to the mike jack (with appropriate attenuation, of course), and key the PTT, you've got an instant crossband repeater! [*Ed. note—The author recently became aware of a crossband repeater function, programmable from the rig's keypad by turning on the HT while depressing the RPT key. Tests performed at 73 HQ, in which I and Jim KA1TGA QSOed via the 470 using a 2m HT and 70cm base station, respectively, confirmed the existence of this function. We also confirmed KB1UM's claim that the rig is locked in low power in this mode. (This was likely set since the high power setting in this mode could lead to receiver desense.) It also appears that Michael's suspicion is true that the audio between bands in this mode is acoustically coupled (that is, the audio passes from speaker to mike), since audio quality is considerably poorer at the end receivers when signals are 470-repeated, than it is when the end rigs receive signals directly, and when the 2m HT received a 2m signal from the 470 via the W2NSD/R repeater. Look for KB1UM's mod for better TX/RX signal coupling in crossband repeating with the 470 in an upcoming issue of* 73 . . . *Bryan NS1B*]

As received from Yaesu, the rig only covered 144–148 MHz. There was no extended coverage, and nothing in the book about how to extend it. I tried the reset procedure used on the '411, and after about five tries, it worked! If you need to extend the receiver, just turn off the rig; hold down both arrow keys; then turn it back on. If it still tunes only 144–148, do it again until it works. Of course, all the frequencies in memory will be lost and require re-entry. Once extended, receive coverage is 130–180 MHz, and transmit is 140–150 MHz. UHF coverage is 430–450 MHz. I am not aware of any way to extend it.

"Once extended, 2m receive coverage is 130–180 MHz, and transmit is 140–150 MHz. UHF coverage is 430–450 MHz."

Problems

The FT-470 is a very nice radio. It has advanced features and, with its ability to monitor both bands at once, is like having two radios in one small, handy box. There are some problems, however, about which you should be aware, to make your operation as smooth as possible.

When monitoring both bands at once, the IF "whoosh" noise from the band not being received leaks into the audio of the received signal. It's not nearly as bad as if the squelch were truly open on both bands, but it is fairly objectionable.

There are two ways to avoid this. You can either turn the subband off (which is fine if the signal you're receiving is on the main band), or you can rotate the balance control toward the band you want.

By the way, there is no indication on the display of which band is being received! If you're monitoring both bands and you get a call, you must either rotate the dial or turn off the subband to see on which band the signal lies. Otherwise, you may respond on the wrong band! In future models Yaesu should consider using a blinking dot or other icon next to each frequency to neatly avoid this kind of confusion.

On the FT-411, rotation of the dial temporarily disables the battery saver, so that you can hear channel activity as you pass through the frequencies or memories. On the '470, that function was omitted (although the saver disables properly during automated scanning operations). Thus, you can turn the knob through all your memories, or a segment of the band, and the frequencies will appear vacant even though they may be bursting with activity! You have to turn the saver off to correct the problem.

The battery saver also seems to "miss" sometimes, taking up to ten times as long as it should to notice a signal. I've seen it wait as much as ten seconds before opening up on a signal that was there the whole time. I suspect that it doesn't wake the rig up long enough for the PLL to reliably lock, although that's only a guess. The receive light will flash on each saver cycle (such as 0.5 seconds), but the squelch won't open. Again, the fix is to shut the saver off.

As on the FT-411, the receive audio is not very good. The '470 has the same speaker and grille, and benefits greatly from the Kaboom Audio Enhancer described in my FT-411 review (*73*, June 1989). (See Figure 1.)

The audio makes a substantial "pop" when the squelch opens, which makes it painful when using an earphone. It's no big deal, however, in normal speaker operation.

As on the '411, the low battery icon gives almost no warning at all before the battery dies. I clocked it at 20 seconds from the time the icon blinked (during transmit on high power) to total radio shutdown.

The rig has the same annoying keypad beeper, with its double beeps and tunes. You can turn it off without losing the AUTO POWER OFF warning beeper.

There's a rubber plug flush with the right side of the rig. Pulling it revealed a hole obviously meant for a coaxial DC power jack (which would be nice to have). Yaesu currently doesn't install this jack on the '470.

Future Fixes

I spoke with Chip Margelli, Vice President of Marketing for Yaesu USA. He confirmed the company's awareness of the squelch leak and battery saver problems, but said that there were no fixes at this time. He did say, however, that when solutions became available, Yaesu would fix any FT-470s sent to them.

Conclusion

All in all, the '470 is a very nice radio. If you don't plan on lots of dual-band monitoring, and are willing to work around the battery saver, you'll probably be very happy with it. It's small, powerful, and offers more flexibility than you're ever likely to need! 73

Michael Geier KB1UM is 73's troubleshooting "Ast Kaboom" columnist. You can reach him at 7 Simpson Court, S. Burlington VT 05403.

Two Meter Mobile Rig

Turn your HT into a 40W, 2m mobile rig.

by Mike Gray N8KDD

The Problem

For several months I had been using my 2 meter HT as a mobile rig. It worked, but I complained frequently about the low RF power, poor audio quality in a mobile environment, and the tiny extension microphone. I really wanted a rugged mobile rig, but I couldn't justify the expense.

The Answer

My solution was to construct a "module" consisting of an RF power amplifier, a comfortable microphone, and a large speaker. Construction was easy and the cost low. I was able to salvage several of the components.

The enclosure is an extruded aluminum box with removable panels and circuit board slots. The external dimensions are 6.5L x 5.5W x 2.5D. You can buy a similar enclosure at the larger electronic supply houses or through the mail.

I simply drilled appropriately-sized holes in the end panel for the connectors and perforated the top panel to serve as a speaker grill.

Amplifier Assembly

The amplifier is a kit from Ramsey Electronics. Performance is just as advertised, and assembly was easy. I have a few complaints, however.

The instructions are complete, but not clear. The text is partially handwritten, and if you follow the order of component installation, you end up having to do some desoldering. It's best to fit the parts on the board first, then decide on the order of assembly. I found that the kit came together the most easily in this order:

1) RF transistor
2) Trimmer capacitors
3) Inductors (coils)
4) Coaxial cable

I also bought the optional RF-sensed relay kit, which includes a nice pretinned circuit board. The relay in the kit will work, but I decided not to use it because it appeared to be too fragile for the task. The terminals were loose in the base, and it was difficult to distinguish one contact set from another. I used a better looking (and more expensive) relay obtained, along with the aluminum enclosure, from Newark Electronics, 4801 N. Ravenswood Ave., Chicago, IL 60640-1084; (312)-784-5100. The relay is a general purpose type made by Potter Brumfield.

It is important to install a large aluminum heat sink on the amplifier board and attach it to the enclosure.

Speaker and Relay

I installed a 3-inch speaker in the aluminum enclosure, attaching it with butyl tape. This installation method may raise a few eyebrows, but it's really a very good way to mount a speaker to an irregular surface. Butyl tape is a bead of very sticky rubber compound used to install windshields. Most glass shops use less than one roll per job, so they have many partial rolls as scrap. A whole roll costs about five dollars, and it has many uses. Cut butyl tape only with a pair of diagonal cutters. The tape will stick to scissors, and you can't tear it off.

Peel some tape off the roll and stick it around the perimeter of the speaker. Determine placement in the enclosure, then carefully press the speaker into place. Be sure you have it in the right place before pressing—removal is difficult!

The relay I chose has 4 contact sets. Only two were needed for the RF, so I used the other two for TX/RX indicators. I used two LEDs because I had them, but one LED which would change color as a function of polarity would be neater.

The Microphone

You'll likely pull a mike off of an old CB rig. Most CB microphones are 600–800Ω. Measure the resistance of an unknown mike with an ohmmeter. The PTT switch and microphone element are in series, and the correct pins can be determined by finding the two which have a resistance of 600–800Ω with the PTT switch depressed (or take it apart and look at it). Yaesu HTs have an audio input impedance of 2200Ω. Consult the manufacturer or owner's manual for the input impedance of other radios. Then, add a resistor between the radio and microphone, equal to the *difference* between the impedance of the microphone and the impedance of the radio.

In my case, I had to install a 1.6kΩ resistor in series to match the radio's 2.2kΩ input impedance:

Audio input impedance
− Microphone impedance
= Resistor value
$2200\Omega - 600\Omega = 1600\Omega$

The pin assignments are industry standard. Connect the pins on the left side (as viewed from the pin-end of the cord connector) of the index key to the audio input (see Figure 1).

I then removed the mike connector, speaker, and SO-239 connector from the CB radio, and gave the rest of it to my nine-year-old son for further disassembly. If you have to buy these components, they shouldn't cost more than 20–25 dollars.

Final Assembly

I used a dry cell case to connect the radio to a 12 volt source on the amplifier board. The case is easy to drill, and a coaxial power jack fits nicely in the side. I used the same size power jack for both the dry cell case and the power connector on the enclosure, so I could use the radio on low power without the amplifier.

I have 3 different types of cables which provide a 12 volt source. All three have a coaxial power connector on one end. One cable has a lighter plug, another has alligator clips, and the third is hard-wired and remains in the truck.

I have more than one HT, so I decided to mount one semi-permanently, using double-adhesive foam. Though well-secured, I can remove it easily if I have to. There are many more ways to mount the radio, such as with hook-and-loop fasteners, or even attaching a soft case to the enclosure so you can slip the radio in and out.

I now have a reliable 40 watt mobile radio with excellent audio and a microphone that won't get lost or inadvertently keyed. (I later added a simple switch in series with the relay coil to provide a high/low power selection.) Using some salvaged components, the total cost was $44. Not bad at all for mobile QRO from an HT!

You may contact Mike Gray N8KDD at 465 W. Maple Rd., Milford MI 48042.

Parts List

1	power amplifier kit	Ramsey Electronics PA-1
1	RF sensed relay kit	Ramsey Electronics TR-1
1	aluminum enclosure	
1	8Ω speaker, 3-inch	RS 40-248
1	microphone	RS 21-1172
1	SO-239 bulkhead connector	RS 278-201
1	miniature phone plug	RS 274-286
1	subminiature phone plug	RS 274-289
1	chassis mount microphone connector	RS 274-002
1	BNC socket, bulkhead type	RS 278-105
2	coaxial power jacks	RS 274-1563
2	coaxial power plugs	RS 274-1569
1	dual color LED	
1	1600Ω resistor	¼ watt*
1	620Ω resistor	¼ watt*
1	BNC patch cable	NPN
1	18-inch length RG-58 coaxial cable	RS 278-1326
1	5-inch length of RG-174 coaxial cable (RG-58 will work just fine)	optional

*Not critical. Improvise, if necessary!

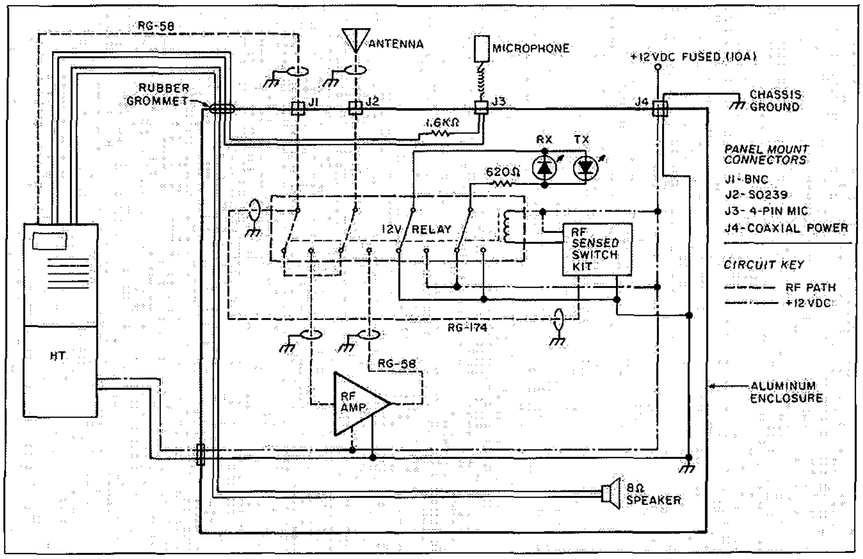


Figure 1. Schematic for the HT booster. Cost for all the parts is less than $50!

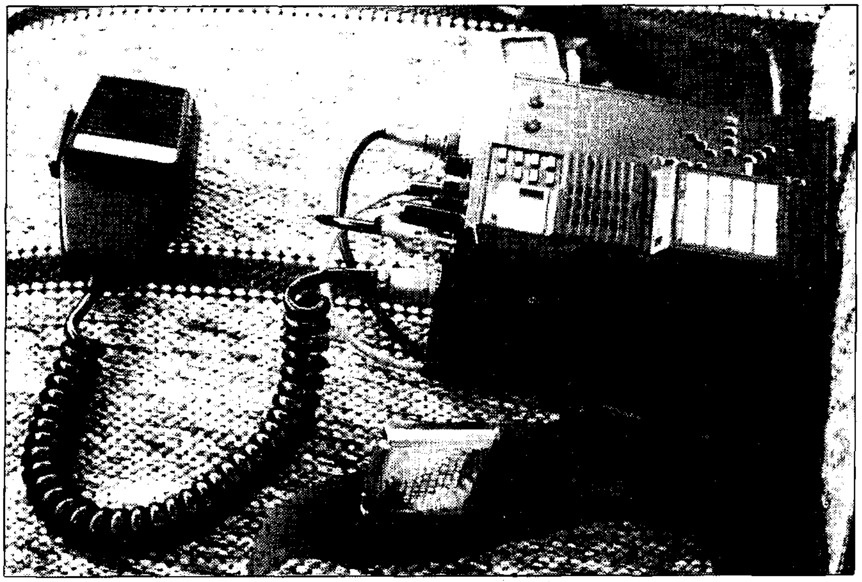


Photo A. N8KDD's mobile station setup. The HT is the Yaesu 23R.

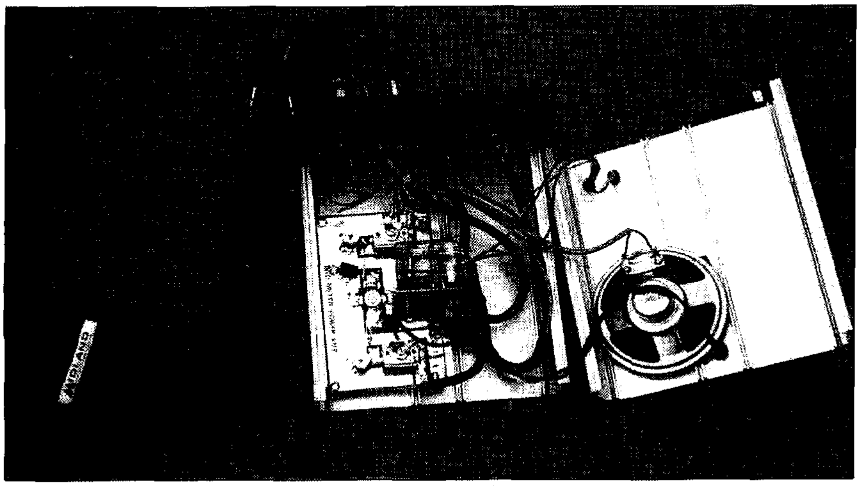


Photo B. Inside the 40W booster.

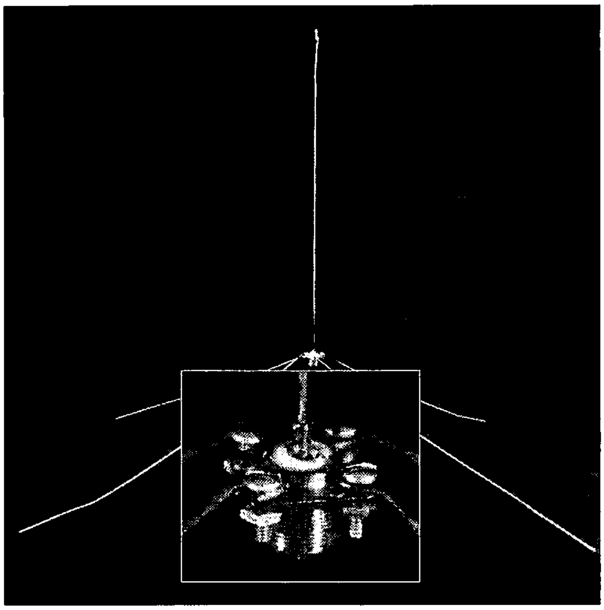
Poor Boy Satellite Station

Coat-hanger hamsat operation!

by Allan J. Fox IV N5LKJ

My satellite chasing began about a year ago, when Carl Kotila WD5JRD, my neighbor, asked me to attend the Houston COM-VENTION '87 with him. There I met Jack Douglas KA5DNP and Andy MacAllister WA5ZIB who were giving a talk on amateur satellites. Jack explained that the Russian satellites RS-10/11 were in a nearly circular, low earth orbit, and did not require expensive equipment or elaborate antennas to operate.

Although I am only a neophyte satellite chaser, I have the satisfaction of having helped several hams become avid satellite enthusiasts on a limited budget.



Two-meter home-brew ground plane antenna.

Original Ground Plane Antenna Station

My station at the time consisted of a 25 Watt, 2 meter all-mode transceiver and a home-brewed ground plane antenna in the attic, similar to one mentioned in the *ARRL Handbook*. I built my antenna in about fifteen minutes out of five coat hangers and a used SO-239 chassis connector. The total cost was less than a dollar.

First, I cut the hooks off the five coat hangers and straightened them out, forming five straight pieces of coated steel wire. To allow a good electrical connection, I put one end of each wire into the hot coals in our fireplace to burn the paint off.

The next step was to solder the bare end of one of these wires into the center conductor of an SO-239 chassis connector to form a vertical radiator. Then, with the aid of needle-nose pliers, I bent a loop in the bare end of the other four wires. This allowed me to attach them to the mounting holes in the SO-239 with four #6-32 ½" machine screws and nuts. These wires were then bent down at a 45 degree angle to serve as radials.

At this point all that remained was to cut all the wires to the proper length. With a tape, I measured each radial 20-3/16 inches and cut them. Then I measured the vertical radiator 19-5/16 inches and cut it. Since I intended to hang this antenna in the attic, I had to cut an extra ½ inch from the vertical and install a ring lug to use as a hanger. However, you could just as easily bend an eye in it.

Now, it was time to connect the feed line and check the standing wave ratio (SWR). Without any adjustments, the SWR stayed below 2:1 throughout the band.

Total investment in this antenna was less than $1.00 and about fifteen minutes construction time.

Now for the Downlink

According to Jack and Andy's presentation, my station contained half the requirements to work RS-10/11—the uplink on Mode A. Since Mode A is 2 meters upper sideband, or CW uplink, with a 10 meter downlink, all I needed was a 10 meter receiver and antenna.

I bought an old Swan 350B transceiver for $50. All I needed was a 10 meter antenna to get on RS-10/11!

While searching the garage for antenna materials, I found an old piece of 12/2 type NM wire, more commonly called Romex. I stripped the Romex to bare copper, and attached it to short pieces of PVC pipe used as insulators. After making a simple 10 meter dipole antenna, I stretched it in the attic and connected it to the Swan. My Poor Boy Satellite Station was almost ready to go on the air!

Frequencies of RS-10/11, Mode A

	Transponder RS-10	
	Downlink (MHz)	Uplink (MHz)
Beacon	29.357	
Transponder bandpass	29.360–.400	145.860–.900
	Transponder RS-11	
	Downlink	Uplink
Beacon	29.407	
Transponder bandpass	29.410–.450	145.910–.950

Finding and Working the Birds

There are several ways to do this. The first and easiest is to ask an avid satellite enthusiast when and where the next good orbit for your QTH will be. Another method is to use a computer with the appropriate software. (See the May '89 issue of *73* for comparisons of different tracking programs.) We didn't have a computer in our household, but we did have a calculator. Therefore, my method was to tune in the beacon frequency and wait until I heard it. This can be tedious, but I have done it several times.

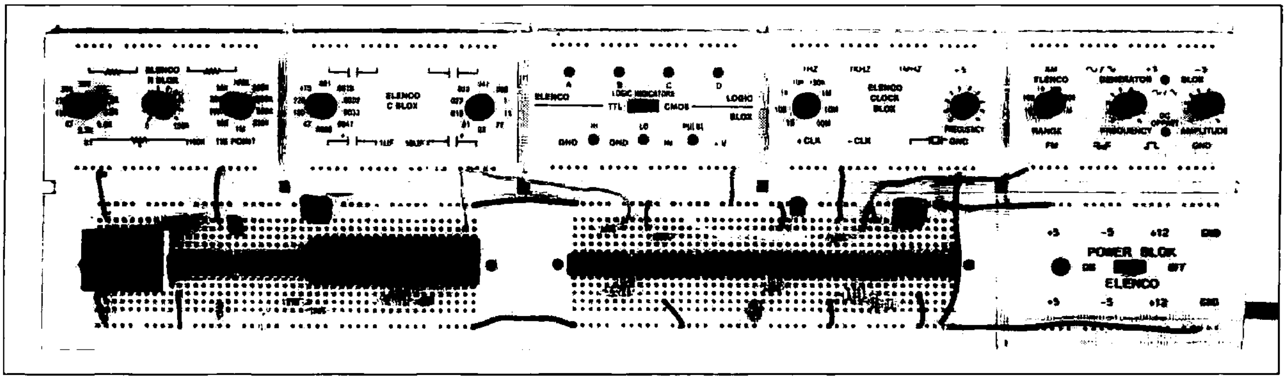
First, tune in 29.357 MHz for the RS-10 beacon, and wait until you hear the beacon transmitting a series of dots and dashes. This indicates that the satellite is in your "window"—that is, your range. You need to work fast because with the optimum pass (direct overhead pass) you will have only 20 minutes with the bird. Note the time and tune through the downlink band, 29.360–29.400 MHz,

73 Review *by Larry R. Antonuk WB9RRT*

Elenco Electronics
150 West Carpenter Avenue
Wheeling IL 60090
(312) 541-3800
Price Class: $19–$29 per unit

Breadblox Breadboarding System

Experimenters, take note!



The complete six-blox Breadblox system—a circuit experimenter's paradise!

It's probably been quite a while since anyone "breadboarded" up a circuit on an actual breadboard, but the name is still with us. Since that time, experimenters have tried spring-loaded clips, styrofoam blocks, you name it—anything to make it easier to test circuit ideas. The current state-of-the-hobby is represented by the white rectangular "proto boards," those interconnected wonders that eagerly accept DIP ICs. These boards even come in desktop enclosures, complete with power supplies, function generators, and several-hundred-dollar price tags. Prebuilt breadboard working stations are great, provided you have the cash and the room to store them in. But what about the guy who doesn't have space in the apartment to set up a workbench? Or the low-budget hobbyist? Is he stuck with his flea market function generator and "proto board," taped to the kitchen table?

Every once in a while, someone comes along with a blend of existing ideas that solves several different problems at once. The engineers at Elenco Electronics have done just that. They've taken the plain old "proto board" and spun it together with some space age surface-mount technology. The result is a series of "Function Blox" that snap onto their regular "proto boards."

The benefits are many. The Breadblox system is small—four different Function Blox and two Bread Blox (proto boards) will collapse into the same space as a small paperback book. Breadblox all interlock, making tor an integrated, easy to move system (an important point for apartment dwellers). They're inexpensive, but provide quality performance. Unlike complete breadboarding systems, Breadblox can be purchased one piece at a time. If you already have a logic probe there's no need to pay for another—just buy what you need.

"Having this much capability at your fingertips makes breadboarding fun again."

The Blox

There are six different Function Blox, identical in form and color to a standard proto board. The system is powered by a small Power Blox. This snaps to the other Blox, and provides +5, −5, and +12 volts for design use and to power the other modules. (The power is actually produced by a plug-in wall transformer, connected by a cable.)

Resistor and capacitor decade boxes are also available. Twenty resistance values from 47Ω to 1 megohm are available, along with a 100k pot. The Capacitor Blox provides 20 caps from 47pF to 10 µF. Unlike the standard decade box configuration, these units have more than one output. The Resistor Blox has an output for the low values, one for the high values, and one for the pot. The Capacitor Blox has a high and low output, and a 1 µF and 10 µF fixed output. This means that you can actually use four caps at once from one decade Blox.

As far as active devices go, the Digital Clock Blox provides a system clock function. Output frequencies from 1 Hz to 50 MHz are available. In addition, you can lock the unit to an external crystal of your choice. The Function Generator Blox produces sine and square waves from 0.1 Hz to 1 MHz, and can be frequency or amplitude modulated. And, if you don't have your own logic probe, the Logic Probe Blox consists of a 1.5 MHz logic probe, and four LED logic level indicators.

The Elenco Electronics Breadblox system is a low-cost, high-quality, well-designed product. Having this much capability at your fingertips makes breadboarding fun again. And who knows, maybe in fifty years we'll all be "bloxing" up our circuits! ■

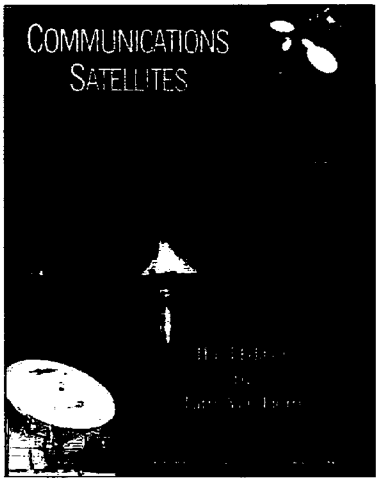
Larry Antonuk WB9RRT has written numerous reviews on test equipment and electronics books for 73 Magazine. *He currently works as a project manager for a land mobile service shop in Keene NH. Contact him at 29 Forrest Dr., P.O. Box 452, Marlborough NH 03455.*

73 Book Review

by Andy MacAllister WA5ZIB

Communications Satellites— A Monitor's Guide

Communications Satellites—A Monitor's Guide
by Larry Van Horn
Third Edition, 1987
Grove Enterprises
PO Box 98
Brasstown NC 28902



Where can you find more satellite data? Right in Larry Van Horn's third edition of *Communications Satellites*. Within the large paperback's 255 pages, Larry covers virtually every type of space communications from hamsats to the Soviet manned-space program. Detailed information on any satellite, whether it's historical information on Telstar 1 or current military Fleetsatcom frequency data, is right here. For those rare items that may have slipped by the author, there are dozens of references included in the appendix.

Complete Coverage

Even if you're familiar with satellite monitoring, don't pass up the first chapter. The material may surprise you with its complete explanation of satellite monitoring needs. Although it's written so the newcomer won't get lost, it also presents information everyone needs for successful listening. Receivers, antennas, and accessories are examined for modes from CW to TV, and for frequencies from the low MHz through the high GHz.

Of particular interest to hams is the section on the amateur satellite program. There is remarkably accurate and complete historical coverage from the birth of OSCAR 1 (Orbiting Satellite Carrying Amateur Radio) to the frequency charts of AMSAT OSCAR 13. Since the book's publication date two years ago, a few AMSAT nets have changed, but the 20 meter net is a constant source of up-to-date hamsat news every Sunday at 1900 UTC on 14.282 MHz.

Space Missions Well-Documented

The ham-in-space activities of Owen Garriott W5LFL and Tony England WØORE are well-documented. The sometimes forgotten mission of DPØSL on the Challenger shuttle is explained in detail, along with little-known facts about the obscure Russian ISKRA hamsats.

I found myself enthralled with the chapters describing weather satellites and domestic TV satellites. The abundant use of photos and figures makes a dramatic presentation. The equipment requirements listing for weather and TV satellite monitoring is sketchy, but satellite frequencies and transmission format listings are quite complete.

Material covering the manned space programs of the US and the Soviet Union is exciting, and inspires an urgent desire to listen in. While the Soviet *Mir* space station activities on 145.55 MHz are too recent for coverage in the book, many of the frequencies used for normal communications to ground stations with official mission operations are listed and their purposes explained.

Intercepting the Military

The lure of catching transmissions from US military satellites is satisfied by the lists of frequencies used by the various branches of the armed services for both communications and remote detection satellites. A Yaesu FRG-9600 or an ICOM IC-7000 covers the UHF bands.

Information on the Soviet unmanned satellites is hard to find. In one chapter, the author has compiled enough historical data mixed with personal observations to help the enthusiast to ferret out Russian signals from space and identify them. Many of the frequencies used by the Soviets are available on reasonably priced VHF receivers. Geoffrey Perry, of the now-famous satellite sleuthing Kettering Group in England, has spent over three decades pursuing Soviet and Eastern Bloc satellites.

His influence is apparent in this section of the book. The satellite history and compelling volume of satellite data overshadow the somewhat disorganized presentation of some chapters and the rather curious typesetting flaws. After the first reading, the book becomes an invaluable reference.

With frequency lists that go from low HF to "light," just paging through the appendix is captivating. Christmas is coming. Put this book on your list, or better yet, buy it now and tell Santa about some new rigs and antennas. 73

Continued from page 24

while listening for QSOs. Callsigns of bird users will usually give you an idea whether the satellite's orbit is tracking from north to south or from south to north. Each orbit progresses 26.4 degrees west of the preceding orbit. Also, each orbit takes 105 minutes.

Now tune the radios to 145.870 MHz CW uplink and 29.380 MHz downlink, and put on a headset. Since satellite operation is full duplex, wearing a headset is a good practice. Feedback can be unbearable without one.

Second, transmit your callsign, and then send a string of dots on CW—just long enough to find your signal. Adjust the downlink frequency for the best copy. Keep the string of dits *as short as possible* so that, if you discover your downlink is on top of a QSO, you QRM that QSO for no longer than absolutely necessary. Adjust your uplink frequency up or down, following with the downlink tuning in step until you find a clear downlink channel. Now you are ready to call CQ and stand by for your first satellite QSO. If you want to operate phone, be sure to change to the USB mode.

Doppler shift is minimal, but noticeable, on Mode A. You will hear some frequency shift of your signal, and you'll have to compensate your downlink frequency slightly. A little practice, and you'll be accurately guessing the location of the downlink signal.

Summary

RS-10/11 are low-orbit satellites (only 600 miles up)—one of the reasons why you can work them with a simple setup. On one occasion my Swan was in for repair, and while a friend was tuning it, we copied a QSO on RS-11. The Swan was connected only to a dead-end piece of RG-58 coax in his attic with no antenna. Although a preamp helps for RS operation, you usually don't need it.

These satellites do have some drawbacks. Since they are in a low orbit above the earth, the optimum pass gives you only 20 minutes of access to the bird. Definitely not much time for ragchewing! I have made, however, as many as four contacts on a pass. Also due to the low orbit, the satellite "footprint"—the area on Earth from which hamsatters can access the bird at a given point in the orbit—has a radius of only 1500 miles. Even with that, however, you can work most stateside hams to get WAS (Worked All States) via these birds from my QTH near Houston, Texas, and from other mid-western states.

RS-10/11 have several modes of operation other than Mode A, such as Mode K, Mode T, combination Modes KA and KT, and the ROBOT (or QSO machine). However, I have no experience with these. Remember, the control on license-class requirements is the uplink frequency! This makes it possible for even a Novice to operate CW when RS-10 is in either Mode K or Mode T.

Good luck! And don't laugh at my poor boy operation. At 1016Z on 25 November 1988, with only 25 Watts into the coat hangers, I made contact and had a QSO with Musa Manarov U2MIR on 145.550 MHz FM direct, while he was on board the Russian Space Station *Mir*. See you on RS-10/11! 73

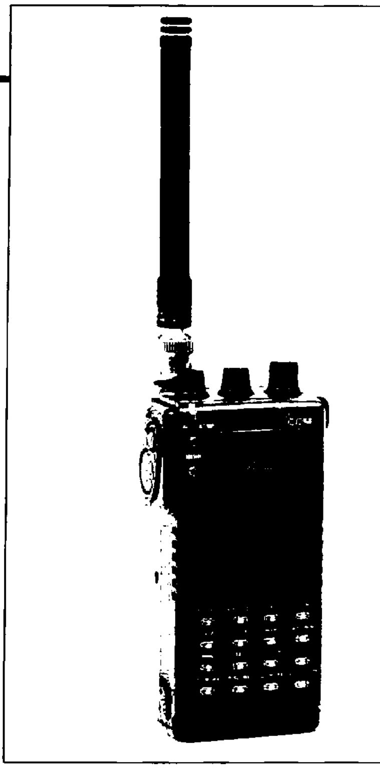
Number 10 on your Feedback card

73 Review by Michael Jay Geier KB1UM

The ICOM IC-2SAT

One of the world's smallest full-featured HTs.

ICOM America, Inc.
2380–116th Ave. N.E.
Bellevue WA 98004
Tel. (206) 454-7619
Price Class: $440



The ICOM IC-2SAT, the ultimate in miniaturization.

Can a walkie ever be *too* small? Not as far as this op is concerned. The smaller the better! So I was especially excited to get to try out a little beauty, the new ICOM IC-2SAT.

The operative word here is "wow." The pictures in the ads don't do justice to the compactness of this thing. At first glance, it looks like a toy. It doesn't feel like one, though. The front is firm plastic, and the back is metal and serves as the heatsink for the RF output stage (as with most new rigs). The radio is very solid and, at about 10 ounces (!), it seems hefty for its size. It is somewhat thicker than most small rigs, and has a contoured, sculpted shape, resulting in an unusual, but attractive, appearance. It fits beautifully in your hand. ICOM has paid great attention to the cabinet design, and it shows, the fit and finish being the best I have yet seen in a mini-rig.

After "wow," your next thought may be, "Where's the battery?" Indeed, there is no battery included in the shipping box. This radio has an INTERNAL battery. Yep, this tiny HT is totally self-contained! It has only a 300 mA-hour capacity, though, so ICOM wisely offers optional batteries, in various voltages and current capacities, which snap on the bottom of the rig in the conventional manner.

Good Looking with Nice Touches

The supplied rubber duck is thin, flexible, and somewhat longer than most provided with today's small rigs. In fact, it is slightly longer than the entire radio. No doubt, it has a bit more gain (perhaps less loss is a better description) than the "stubby" ducks usually employed, and that's important here because the rig is rated at only 1½ watts output on high power with the internal battery. The package includes a belt clip (though I can't imagine wanting to put such a small rig anywhere but in a pocket), a wrist strap, wall charger, and a fairly well-written manual with a full schematic. Also included is a crib sheet, a very handy item with a rig this complex. Various options, from the batteries to speaker-mikes and carrying cases, are available.

The top of the radio has the antenna connector, squelch, volume, and "dial" knobs. Also located on top are the DC input, mike, and earphone jacks. The DC jack permits direct operation up to 16 volts (meaning you can plug it into your car cigarette lighter or a DC power supply) and internal battery charging.

On the rig's left side are round, rubberized PTT and FUNCTION buttons, which have an especially nice feel. The LIGHT button, which is also used for a few seldom-performed programming operations, is on the right side. The mike and speaker are located in the middle, with the keypad below them. The keypad has very tiny keys, but they are well separated from each other and easy to press. They are also set in from the front, making accidental keypresses unlikely. It's a nice touch.

Readout Display

The LCD is very large and easy to read, although it loses contrast unless viewed from the bottom. The display shows frequency, ± offset (called "duplex"), memory channel number, power output selection, S-units, and other assorted operating data. It is a 5½ digit display, with no "0" or "5" at the end of the frequency. To display frequencies ending in a 5, a small "50" appears. Many new rigs are taking this approach, and I do not see the advantage; a fully displayed frequency avoids ambiguity and is easier to read.

For night operation, a press of the LIGHT button illuminates the display with an unusual, deep reddish-orange color generated by two LEDs, one on each side of the LCD. It's very pretty, but not overly bright. It should be adequate in most situations. The lamp circuit has a timer that keeps the display lit for a few seconds after the last keypress, or you can turn it off manually by pressing the LIGHT button again. The keypad buttons do not light up.

Alternate Frequency Entry

Another recent trend has been toward the inclusion of a "dial" knob on top of the rig, and this is a good thing. It began with the Yaesu FT-23R, which did not have direct keypad frequency entry, making the knob essential. Now, even direct-entry rigs like the IC-2SAT have the knobs, and they are very handy, permitting easy selection of memories and CTCSS tones, as well as an alternate method of frequency entry.

This rig has provisions for CTCSS boards (an encoder or encoder/decoder) and a DTMF decoder. Neither is included. The new DTMF feature permits coded squelch using the tones generated by any rig with a keypad. Thus, you can use it to ignore any station not transmitting your personal code. You can use it with multiple codes, and even display them on the LCD so you know who's calling! This could prove very handy in large cities where repeater overcrowding makes continuous monitoring tedious. To my knowledge, the IC-2SAT is the first handheld to incorporate such a decoder.

Memory Management

The rig has 48 memories which store frequency and offset, including a handy "call" memory accessible with one keypress. They are fix-tuned. That is, they cannot be used like separate VFOs. (The contents of any memory can easily be transferred to the VFO, though.) The first 10 can hold odd offsets, but not independently entered RX and TX frequencies; you must know the offset. The other memories use whatever offset has been programmed into the VFO. The choice of up or down, of course, remains independent.

Memory management, while fairly flexible, is also a bit unusual. There are four banks of 10 memories each. To get to a memory in your current bank, all you need to do is press its number on the keypad. (You must, of course, be in memory mode first.) To get to a memory in another bank, use the dial knob to step through all the memories in between, or press the MR key until the bank appears. Once you have selected the memory bank, enter the last digit from the keypad.

Here's an example: You are at memory 3 and you want to go to 28. Press MR key until the "tens" digit becomes a 2. Then press 8 on the keypad. It's a bit less convenient than simply pressing "28" and then MR, but it's not hard to get used to.

Skipping and Scanning

Memories can be skip-scanned or hidden entirely. They can also be used to make the

VFO skip certain frequencies during band scanning, another feature I had never seen before. In fact, the frequencies of memories set for skip-scan will also be skipped during VFO scan. It seems like a good idea, but it doesn't really work too well because the rig stops on adjacent frequencies.

The IC-2SAT has several kinds of scanning, including full-band scan, programmable limited-band scan, memory scan and priority watch. Memories are scanned at about 3 per second, a bit slow by today's standards. (VFO scanning is significantly faster, but still not zippy.) A twist of the dial knob lets you change scan direction at will. All memories are scanned together, as if in one bank. You can mix modes. For example, you can have the priority watch check a new memory each time it checks, combining memory scan and priority watch in one operation.

In Addition...

You can set the automatic power-off feature to shut the rig down after 20, 40 or 60 minutes of inactivity. It warns you with four beeps, and the warning works even if the keypad beeper is shut off. The beeper, by the way, is soft and unobtrusive. It is one of the few made today that I like to keep turned on.

The timer function includes a real-time clock, and you can set it to turn the radio on at a preset time. The battery saver interval can be set for ½ second, 2 seconds, or off. This seems a bit limited. A choice of around one second would have been nice.

Where most HTs have a *reverse* button, the IC-2SAT has one called MONI. On simplex, it simply opens the squelch. When you're using an offset, however, it shifts to the TX frequency too! It's nice if you want to check the input frequency of a repeater. If, on the other hand, you just want to open the squelch because the repeater's signal is weak, you'll have to use the squelch knob. Also, you cannot transmit on the reversed frequency pair, as you can with a normal *reverse* switch.

The rig has a 10-number by 15-digit autodialler. While sending, it keeps the rig keyed for the duration of the number, even if you let go of the PTT. Also, you hear the tones as they are transmitted. Programming numbers is fairly straightforward, but sending them is not. If you happen to have already selected the autodialler memory you want, then you simply press the DTMF button with the PTT down, and the number is sent. If, however, you need a different number, you must first go to DTMF memory mode, select the desired memory, exit that mode, press PTT and then DTMF. This requires five keystrokes, nearly as many as most numbers! This complexity limits the usefulness of the autodialler unless you usually use only one number anyway.

Radio Performance

The receiver, which covers 138–174 MHz, is very good. It is reasonably sensitive and selective, and the sensitivity holds up very well outside the ham band. The received audio sounds surprisingly good for the size of the rig. An experiment with a Kaboom Audio Enhancer (see the Yaesu FT-411 review on page 14 of the June '89 issue of *73*) improved the audio even more, but the enhancer probably isn't necessary with this radio.

The transmitter, which covers 140–150 MHz, is rated at 1.5 watts output on high power when you are using the internal battery. At 13.8 volts, you get more than five watts output. Reports regarding the transmitted audio suggest that it is clear, but a bit tinny and underdeviated. Overall, it was considered quite acceptable, but not great. It may be that the deviation is an adjustable parameter, but I have no way to know.

Nit Picks

This rig has many advanced features, some common ones seem to have been left out. There is no low-battery warning of any kind. When the battery dies, attempts to transmit result in a flashing display, with no RF output. At that point, of course, it's too late.

In addition, there is no auto (ARRL band plan) repeater shift, a common feature on new HTs. Here, you must set the offset memory. Speaking of repeater shifts, offsets are available only in 25 kHz steps. You can't, for example, enter in a 610 kHz shift. I'm not aware, however, of any repeaters with offsets that are not a multiple of 25 kHz; all the ones I've used have the standard (600 kHz) or 1 MHz split. Also, the display doesn't indicate the status of the auto power off and battery saver functions. You have to go to SET mode to find out if they're on or off.

The manual doesn't have any instructions on how to receive outside the ham band. When entering frequencies from the keyboard, only the last four digits are accepted, so getting out of the 14X.XXX band seems impossible. In fact, the rig is already set up for extended coverage, but you can't get to it directly. You must first select the 10-MHz digit with the quick-tuning-step function by pressing the function button and rotating the dial knob. When you've got the one you want, you then either continue using the dial knob, or you enter the last four digits from the keypad. The whole thing is very inconvenient.

You write memories by holding down the MR/MW key while pressing the function key. You must hold it down for about one second, and entry is confirmed with a series of beeps. With the keypad beeper turned off, you can't tell whether entry is complete, because nothing happens on the display.

The displayed initials for some of the modes and functions are odd, and unexplained in the book. For example, the offset is "OW" and frequency skip is "PS." It's hard to remember this stuff if you are never told what it means.

Many programming procedures are complicated, and not all are consistent. For instance, most modes are terminated by pressing CLR, but the clock setting mode is terminated by pressing PTT. CLR won't work. Some procedures require holding the LIGHT button and a keypad button while turning the rig on. ICOM's walkies use procedures very different from those of the other major manufacturers, and in all fairness, I haven't had that much experience with the ICOMs. I suspect that if you have owned or used other ICOM HTs, this unit will be fairly easy to learn. If not, though, you're in for some surprises, and you will probably want to keep the crib sheet in your wallet.

The review unit did not come with the CTCSS or DTMF decoder boards, so I wasn't able to test those functions. However, the otherwise well-written manual is extremely confusing in the sections describing the use of the DTMF decoder, and I just couldn't make heads nor tails of it. For instance, two modes, *pager* and *code squelch*, are offered, each with its own programming procedures. Except that one uses 7 digits and the other uses 3, I couldn't see the difference between them. Perhaps if I could have tried the procedures, they would have made more sense.

ICOM's ads list the power output as 2 watts, yet the specs in the book list it as 1½ watts. The actual power, as measured on my dummy load/wattmeter (admittedly no laboratory standard) was about 1.75 watts. Also, there are four power level settings available, but only two work with the internal battery. The other two work at higher voltages, such as from a car battery.

The back of the rig gets significantly warmer at 1.75 watts output than does my Yaesu FT-411 at 2.5 watts. This, and the very quick battery depletion, lead me to wonder whether the transmitter efficiency might be low. There are no current drain specs given for normal 7.2-volt operation (the only specs are for 13.8-volt use), so I can't know for sure.

As with most extended-receive rigs, there are some birdies and spurious responses, all well outside the ham band. In particular, a local FM radio station appears repeatedly in the 160 MHz band. None of these anomalies should affect normal use.

Unlike all the other microprocessor walkies I've used, this one does not use a standard lithium battery for backup. Instead, a *rechargeable* lithium battery is used. This might seem like a good idea, but the manual states that this battery will go dead and empty the memories about one week after the main battery is left discharged. So, if you run it down and then go out of town without it for a week, you may come home and find all 48 memories (and all your parameter programming) gone! ICOM may want to consider adding in 7-year lithium cells in future versions for memory/parameter management.

A Terrific Mini-Rig

This is one nifty little radio. Clearly, its greatest advantage is its size, suggesting that the best uses for it are those which do not require an external battery. After all, once you hang a battery on the bottom, it isn't significantly smaller than other mini-rigs. If your usage is light, and especially if you can use low power (the company suggests that the internal battery will be discharged quickly on high power, and they aren't kidding), this rig offers you the ultimate in miniaturization. I'm sure it will prove popular. ICOM's definitely got a winner in the IC-2SAT! 73

Michael Geier KB1UM is 73's troubleshooting "Ask Kaboom" columnist. You can reach him at 7 Simpson Court, S. Burlington VT 05403.

73 Review *by Kenny A. Chaffin WB0E*

Ramsey QRP-40 Transmitter

Ramsey Electronics
793 Canning Parkway
Victor NY 14564
Tel: 716-924-4560
Price Class: $30. Case kit: $13

Get a 40m transmitter quickly and easily with this kit.

Ramsey Electronics of Victor, New York, provides a painless way to get involved in QRP construction and operation. They offer three 1-watt output QRP transmitter kits, for 20m, 40m, and 80m. I first saw these kits advertised in *73 Magazine*, and I called to find out more about them.

Fast Delivery

I ordered the 40m version, since that's my favorite QRP band, along with the case kit. When it arrived two days later, I could hardly wait to heat up the old soldering iron. Unfortunately, I had to wait a bit. We have three kids all under three years old, the most recent addition being three weeks old. As you might imagine, this sometimes causes QRM with my hobbies.

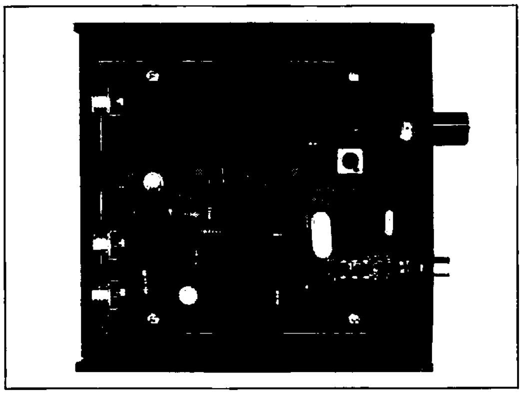


Photo A. Component side board of the QRP-40 transmitter. Parts installation is easy since the board isn't crowded.

Even so, I didn't waste any time opening up the package and checking it out. The case was machined and marked, and included the front panel knobs, but the connectors and switches were part of the QRP-40 kit. The case kit consists of the plastic case itself, custom front and rear panels, and knobs for the controls which come in the transmitter kit. Having a custom case, though not essential, simplifies and completes a project. I was pleased with everything I saw.

Design and Tuning

The QRP-40 arrived in a plastic bag designed to hang on a pegboard display. The bag contained the 4" x 5" (100 x 127 mm) circuit board along with all of the other parts. The first thing I did was pull out the one-page instruction sheet and examine the circuit. It's a four-transistor transmitter design with a VXO arrangement. That it's a VXO circuit wasn't mentioned in the advertisement I saw, but it's explained in the Ramsey catalog.

I was immediately pleased that it allowed for two crystals selectable by one of the two front panel controls. The other control is a potentiometer for tuning the VXO. The instruction sheet indicated a tuning range of 10 kHz, which is about what could be expected from a VXO circuit on 40 meters.

It's disappointing that the crystal is for 7150 kHz, nowhere near either the standard 7040 kHz QRP frequency or the 7110 kHz Novice QRP frequency. If you want to operate the recognized QRP frequencies, you have to either order the right crystals or pull them out of other equipment. The supplied crystal is a standard HC18/U from Jan Crystals, but the instructions say that almost any style will work.

Antenna

I thought I'd need an antenna switch to connect my vertical antenna to either the QRP-40 or my transceiver, as in the old days when I had a separate transmitter and receiver, but I didn't. The QRP-40 has a built-in diode switching arrangement that provides an antenna output to a receiver! Good job, guys.

Next, I checked all the parts against the parts list. Some of the transistors come in a couple of flavors, but the variations are all listed, so it shouldn't cause any confusion. A couple of hand-written additions to the instruction sheet concern the resistor-like inductors that are part of the kit. If you aren't familiar with this type of inductor, which looks almost like a resistor, it can confuse you. The most notable difference is that the inductors have silver bands on both ends and the color code in the middle.

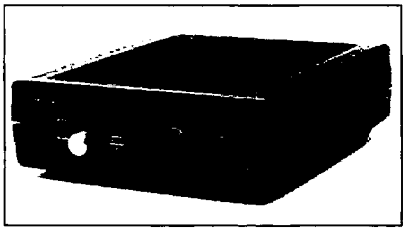


Photo B. Front...

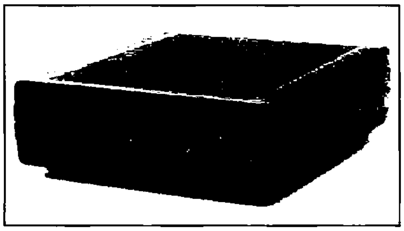


Photo C.... and back panel of the QRP-40.

QRP-40 Transmitter Kit

Power out	1 watt
Circuit	four transistors, crystal control
Controls	A/B crystal switch
	VXO tuning control
Power	12–14 VDC

After verifying that nothing was missing, I carefully put all the parts back in the bag and waited for an opportunity to begin.

Assembly

My chance came the following day. With the kids and wife napping, I sneaked to the basement and heated up the ol' Weller soldering iron. Even though the QRP-40 is a relatively simple circuit with about 50 parts, it is by no means a Heathkit. It doesn't guide you step-by-step (e.g., "Insert R31 [red-brown-green] at position A12."). For this kit, you have to know what resistors and capacitors are, and how to read their values. The entire assembly instructions consist of nine steps:

1. Orient the circuit board.
2. Install jacks and switches.
3. Install capacitors.
4. Connect a 100Ω resistor to a 220 μH inductor, and install as shown on the figure.
5. Install resistors (47k on solder side).
6. Install diodes and transistors.
7. Install inductors.
8. Install crystal.
9. Check all solder connections.

The only difficulty was positioning a couple of the transistors. Q2, in my kit, is almost round. It took me a second to find the flat side. The parts placement drawing was a great help in figuring this out. Q4, on the other hand, is almost square. It does, however, have a couple of missing corners on one side. If you assume this is the rounded side, and the other side flat, you'll have it right.

Unused holes on the circuit board are indicated on the layout drawing, something often overlooked in kits. This makes it easier to check placement.

I completed the entire assembly by the time the kids got up from their naps, about an hour and-a half. This was enough time for me to check and make sure I'd installed and soldered everything properly. Depending on your experience with kit building, allow from one to three hours.

Apprehension

Power input can range from 12 to 14 volts, so I connected the board to my 2 meter rig's power supply. I had to scrounge around a bit to find connectors and adapters to connect the dummy load and antenna. The QRP-40's two antenna connectors and key connector are all phono plugs. Fortunately, from my work with the HW-7 QRP rig and a couple of home-brew preamps, I had phono-to-UHF adapters.

The switch for the crystals is not marked on either the board or the schematic as to which position is for which crystal, but it's relatively easy to figure out. The front panel of the case is marked, but, for you who get the kit without the case kit, remember that *out* is position A, and *in* is position B.

I selected position A, the 7150 kHz crystal, and connected the transmitter to my antenna via a wattmeter. I turned the power switch on for about half a second and then quickly backed it off. No smoke. Good. Everything looked fine, so I turned the power back on and pressed the key. Yeah! Power out! The wattmeter showed about 1 watt.

Adjustment and Tuning

The next step was to check the receiver and verify the frequency. Sure enough, it was at 7145 kHz. Checking the range of the tuning control, which is a 5k pot, gave a range of about 7145 to 7150 kHz. The only internal adjustment is a coil in the oscillator circuit that adjusts the tuning range. Trying various settings and adjustments, I was able to get the lower limit down to about 7140 kHz, but I could never get a range of more than 7 kHz. Close, but not quite the claimed 10 kHz. The tuning range of a VXO is highly dependent on the type of crystal and other factors, so I don't consider this a significant problem.

Later, I found some old FT-243 style crystals in my junk box and decided to try them just for grins. They seemed to work, though the tone of the output signal was nothing to write home about, and the tuning range was non-existent. It's probably best to avoid older crystals and stick with the newer canned crystals. I tested the transmitter with a wide range of crystals, and the power output remained 1 watt, regardless of frequency.

Installing the board in the case is simple. Ramsey provides rubber feet for the bottom half of the black plastic case. The top and bottom are identical, except that the bottom has two holes for screws to secure the case. The circuit board is a tight fit. Place the front panel on the board and fit these together into the bottom. Four screws hold the board in place. After screwing the board down, you can attach the back panel and top.

I ran into a slight problem with the button for the crystal select switch. It was too loose to fit on the switch shaft, at least in my kit. Folding a strip of paper and inserting it between the shaft and the button snugged up the fit enough.

On the Air!

Operating with 1 watt with a vertical is a world apart from operating with a kilowatt and a seven element beam. You have to use a few tricks, like tail-ending, calling a station when he finishes a QSO, or answering a CQ rather than calling CQ.

At first I had no luck, even following my own advice above. Then I remembered, from the days of separate transmitters and receivers, that a CW signal has two sidebands. Most modern tranceivers use only one of these. After getting on the other sideband, opposite of the way my Heath 5400 normally operates, it worked. The first CQ I answered heard me. K5KS in Albuquerque, New Mexico, was my first 1 watt contact. He valiantly gave me a 559, and we chatted for a few minutes while I attempted to contain my enthusiasm. It's quite a feeling to have a QSO going well, and even rag-chewing a little, on 1 watt. Amazing!

The next day I had a contact with Joe N3NJ in Pittsburgh, and others around the States. I haven't worked any foreign DX with the QRP-40 yet, but, since it's been done often in the past, so it's only a matter of time. I can hardly wait to work New Zealand with 1 watt.

Conclusion

Ramsey has a limited warranty on its kits and telephone help if you have problems, but with the simplicity of this particular kit it should be smooth sailing.

The final QRP-40 transmitter, installed in its case, measures about 5" x 5½" (127 x 140 mm), and is a nice-looking, although small, addition to my station.

Is it worth the money and effort? Absolutely. If you're looking for an easy way to build a QRP rig, this is it. Quick delivery, complete kit with good instructions, and easy operation. And it's always more fun to get on the air using something you built yourself. If you're not into scrounging for parts, this may be the kit for you. Happy QRPing! 73

Kenny A. Chaffin WBØE, 2942 South Wabash Circle, Denver CO 80231.

Color SSTV for the Atari ST Part I

Atari ST owners already have 99% of a color video station.

by John W. Langner WB2OSZ

A catchy ad contains a picture with a transceiver, a television, a tape recorder, a missing box, and the caption, "You already own 75% of a color video station." Reading the fine print, you discover that the missing piece costs $1295. It's a very fine and popular piece of equipment, but the price is a bit steep for someone with only a casual interest in trying a new mode of communication.

A few years ago you didn't have much choice. You could either buy a commercial scan converter or home-brew a very complicated device. Very few people had the skill and patience to build it. Modern home computers, though, have lots of memory, plenty of processing power, and adequate color graphics displays to serve as the base for a slow-scan television system. Just add a simple interface and suitable software and you are on the air with SSTV video.

Part I of this two-part article gives you background on the development of amateur SSTV and describes a low-cost SSTV interface and software for the Atari ST computer.[1,2,3] Part II will show you how to build a high performance color SSTV interface for this widely available computer.

Table 1 lists the features of this system. Before continuing, however, let's first look at how SSTV pictures are transmitted.

SSTV Transmission Formats

The original slow-scan television standard uses a tone of 1500 Hz for black, 2300 Hz for white, and frequencies in between for shades of gray. The 120 scan lines are separated by five-millisecond horizontal sync pulses of 1200 Hz. Vertical sync, between frames, is also 1200 Hz, but 30 milliseconds long. Figure 1 illustrates a single scan line.

Early color pictures were transmitted with the frame sequential method. Three separate black and white frames were generated with a red, green, or blue filter in front of the TV camera. On the receiving end, a triple exposure photograph was made with red, green, and blue filters between the CRT and camera. As technology improved, it became feasible to keep all three frames in memory and display them at the same time on a color TV. Figure 2 shows an example with five vertical color bars.

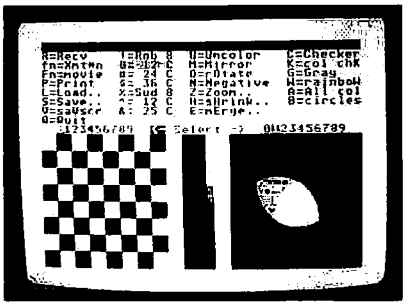


Photo A. Atari ST SSTV test patterns.

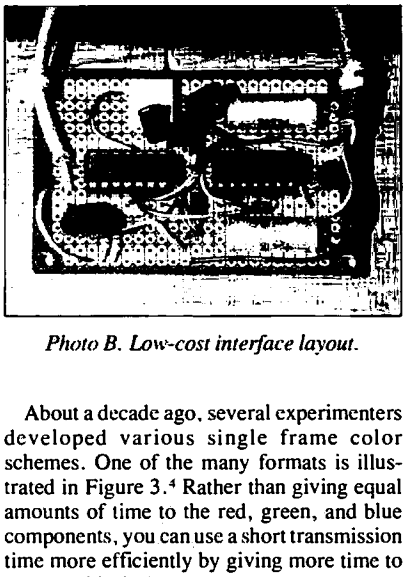


Photo B. Low-cost interface layout.

About a decade ago, several experimenters developed various single frame color schemes. One of the many formats is illustrated in Figure 3.[4] Rather than giving equal amounts of time to the red, green, and blue components, you can use a short transmission time more efficiently by giving more time to green. This is because our eyes are more sensitive to changes in green. The first two-thirds of each scan line is for intensity of green. The remainder is for alternating red and blue information, which is the average of two scan lines.

The Robot transmission formats are different in that they transmit luminance (brightness) and chrominance (color) information rather than red, green, and blue.[5] Luminance, represented by Y, is computed as $0.30\,R + 0.59\,G + 0.11\,B$. Chrominance is conveyed by the two values $R - Y$ and $B - Y$. Table 2 contains luminance and chrominance values for several colors.

The possible ranges of Y, $R - Y$, and $B - Y$ are scaled into the range of 1500 to 2300 Hz for transmission (see Figure 4). At the receiving end, you can calculate original RGB values with a little elementary algebra.

A benefit of this system is that the first two-thirds of each scan line contains a black and white compatible signal. Someone with an old eight-second, black and white system can receive a 12-second color picture properly, and not even realize it was transmitted in color!

Operation

Now that you have a little background and history on SSTV, let's look at the system I've put together. To start with, there are currently two versions of the software. Version 0.9 has the capability to send and receive pictures, manipulate images, generate test patterns, and read picture files from disk. The full version, 1.1, can perform all the functions of 0.9, plus save images to disk. Version 0.9 is available at various user groups. Two groups I know of are: Atari Microcomputer Network, John Adams KC5FW, 17106 Happy Hollow, San Antonio, TX 78232, USA; and ASTUR (Atari ST Users on Radio) GEERAERT Michel, W. Elsschotlann 21, B-8460 Koksijde, Belguim. To the first group, send a formatted disk and $2 for the program; to the second group, send two disks and three IRCs (one disk will be returned).

Version 1.1 is available from A&A Enginnering in Anaheim, California. Version 1.1 is useful only for the high-performance interface, described in Part II of this article, to appear in the January '90 issue.

The screen is divided into several regions (see Figure 5). The top line contains messages, and a prompt for keyboard input, when necessary. The menu contains a list of the available commands. The selection line indicates the currently selected monitor and images. Each "TV monitor" displays an image with 128 by 120 pixels with 256 colors. You can adjust brightness and contrast with the aid of the color bars.

How can 256 colors be displayed at once? In low resolution mode, the ST can normally display from a palette of 16 colors picked from the 512 possibilities. You can increase the number by reloading with a different set of colors during horizontal blanking inter-

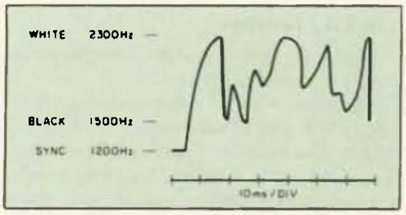


Figure 1. Single scan line plot for the original 8-second black and white SSTV format.

rupts. However, there is still a maximum of only 16 colors on each scan line.

This program uses a different technique. Two different screen images are built in memory. Each has a different palette of 16 carefully chosen colors. During each vertical blanking interrupt, the opposite screen and palette is selected to produce a total of 256 colors. The 30 Hz flicker becomes a little wearing to stare at all day, but it works very well for shorter periods.

Photo A shows the command menu. The first column contains the commands to receive, transmit, print, load from disk, save to disk, and quit from the program. The second column shows the transmission formats. The third column contains functions to manipulate images. The last column contains commands to generate test patterns. The currently selected format is highlighted with a yellow background.

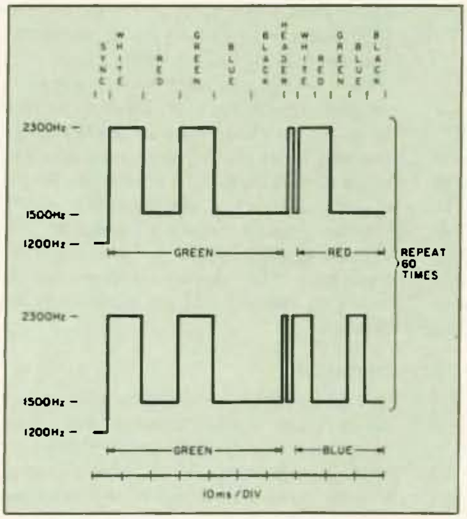


Figure 3. Suding 12-second single frame color format.

Most commands require only a single keystroke. Menu items ending with ".." require additional input. For instance, when saving an image to a disk, you must specify a file name. A flashing text cursor appears along with a prompt for input. While a command is being executed, the menu item is highlighted by a red background. This assures you that you have pressed the correct key. When the background color returns to normal, you know the command has been carried to completion.

At any time, one of the two "TV monitors" is the active or "selected" one. Most of the commands use the content of the selected monitor. Press the left arrow key to select the left monitor. The "<-" on the selection line is then highlighted in red. Press the right arrow key to select the right monitor; "->" will then be highlighted.

The 10 image-buffers in memory are numbered 0 through 9. The TV monitors can display any of the image buffers. A number above the monitor will be highlighted to show which image buffer it's displaying. You can select an image for the currently selected monitor by pressing one of the digit keys, 0 through 9. Press the up or down arrow key to select the next higher or lower image buffer.

There is one more image buffer that isn't displayed on the screen. Commands that modify an image buffer first copy the old image to the save-buffer. The UNDO key exchanges the currently selected image and the saved image.

Sending and Receiving

The first step for sending or receiving is to select the transmission format from the second column of the menu. Press "R" to start receive mode. The first frame will go into the current image. Subsequent frames will go into consecutive image buffers, and the selected monitor will alternate. Terminate receive mode by pressing the space bar.

Function key "n" transmits the current image *n* times. Press the shift key at the same time to transmit consecutive images, once each. For example, if image 6 is in the selected monitor, and you press Shift-F3, images 6, 7, and 8 will be transmitted. Press the space bar to terminate transmission early.

Printing

You can print the image on an Epson or compatible dot matrix printer by pressing "P," for Print. Each screen pixel is converted to a 4 x 4 group of dots on the printer. Each group can have 0 through 16 dots printed, so 17 gray levels are available when viewed from a distance.

Loading and Saving Images

Press "L" to load a picture from a disk file, and "S" to save a picture to a disk file. This program accepts the file formats of the most popular drawing programs. The proper conversion routine is selected by the file extension: NEO for NEOchrome, PI1 for Degas, or STV for its own file format with 256 colors.

"V" saves the entire screen in a file called SCREEN.NEO. You can load this file into memory to transmit a self-portrait.

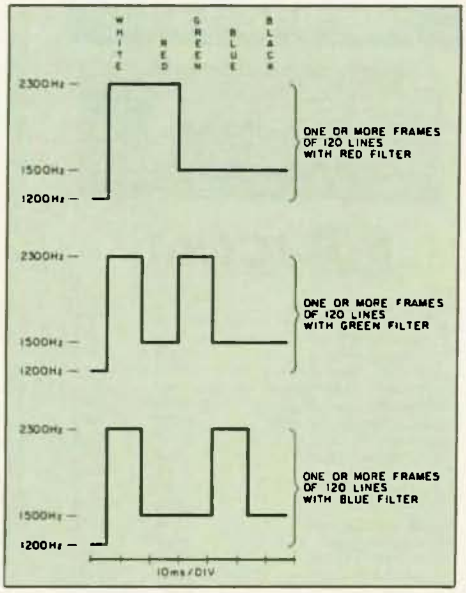


Figure 2. Frame sequential color SSTV. Three b & w frames were sent for red, green, and blue components.

Image Manipulation

You can manipulate the image in a variety of ways. Uncolor (U) converts a color image to black and white so that you can see what a color picture will look like transmitted or printed in black and white. However, you don't have to uncolor a picture before transmitting it in black and white or printing it out. Mirror (M) swaps the left and the right sides of a picture. Rotate (O) turns the image 90 degrees. Negative (N) inverts all the colors: white becomes black, blue becomes yellow, etc.; medium gray is hardly affected.

Zoom (Z) expands one-quarter of the image by a factor of two so that it fills the entire "monitor." At the prompt, type a single digit to select which quarter of the screen you want to expand: 7, upper left corner; 5, center; 2, center bottom; and so on. These positions

Figure 4. Robot 12-second single frame color format.

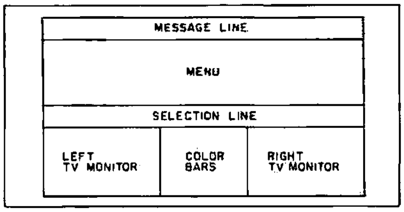


Figure 5. Screen layout for the SSTV program.

Low Cost Interface

Figure 6 shows the station configuration for the low-cost interface.

The Atari ST has a built-in sound generator chip which may be used to produce tones for SSTV transmission. I have received good signal reports by holding a microphone up to the computer's speaker, but the exact placement has a big effect on the resulting signal quality. The computer has no provision for audio input, so you'll need a simple interface for receiving. The schematic is in Figure 7 and the parts list is in Table 3.

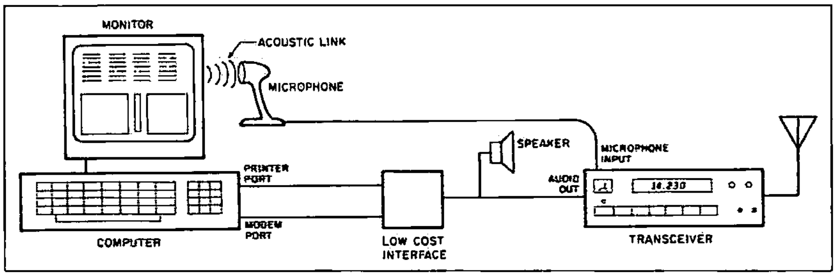


Figure 6. Station layout using the low-cost interface.

conform to the numeric keypad. Shrink (S) does the opposite of Zoom.

Finally, use Merge (E) to combine multiple images into one. Specifying only one source image produces a copy of that image. Not specifying a source image clears the current image buffer.

Pattern Generation

"C" produces a traditional 8 x 8 black and white checkerboard pattern. "K" produces a more colorful alternative. Press "G" for a gray scale pattern, "W" for colors arranged in rainbow order, and "A" to produce 256 rectangles with all the possible colors. Finally, "B" generates overlapping red, green, and blue circles. The intersections of these circles are yellow, cyan, magenta, and white. Again, see Photo A to see the last pattern.

Table 1. Summary of Features

Sends and receives these popular formats:
- Robot: 8 second black and white; 12, 24 & 36 second color
- Volker Wraase: 24, 48, and 96 second color
- AVT: 90 second color; 24, 94 second color, receive only

Screen contains:
- Two images with 128x120 pixels of 256 colors
- Menu of available commands

Test pattern generation:
- Checkerboard, rainbow, all colors

Image manipulation:
- Mirror, rotate, zoom, shrink

Load and save images with various file formats:
- NEOchrome, Degas, Own format with 256 colors

Keep ten images in memory for instant access.

Print images with 17 gray levels.

Can use either low cost (about $7) interface connected to modem and printer ports, or high performance interface connected to MIDI port.

U1 is a phase-locked loop which locks onto the strongest tone present. U2 produces a square wave with exactly a 50% duty cycle. Q1 provides protection for the computer; the output of U2 may exceed 5 volts.

The RS-232 port is used only as a source of plus and minus 5 or 6 volts. The busy input of the printer port happens to be connected to a hardware timer which is used to measure the length of each pulse. You must adjust R3 for an output of roughly 1750 Hz with no input. You don't need a frequency counter for this adjustment; pressing the "*" key on the numeric keypad will display on screen the approximate frequency of the signal from the interface.

Conclusion

A phase-locked loop works well with a strong, clean signal, but not so well under noisy conditions. Holding a microphone near a speaker driven by a square wave isn't ideal for generating a clean signal, and swapping

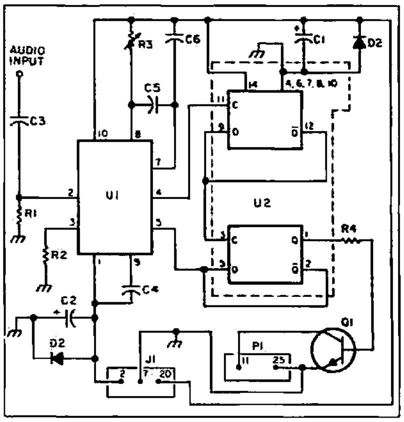


Figure 7. Low cost interface for receive.

Table 2. Conversion of RGB to Luminance and Chrominance

Color	R	G	B	Y	R − Y	B − Y
black	0.0	0.0	0.0	0.0	0.0	0.0
dark gray	0.25	0.25	0.25	0.25	0.0	0.0
medium gray	0.5	0.5	0.5	0.5	0.0	0.0
light gray	0.75	0.75	0.75	0.75	0.0	0.0
white	1.0	1.0	1.0	1.0	0.0	0.0
blue	0.0	0.0	1.0	0.11	−0.11	0.89
green	0.0	1.0	0.0	0.59	−0.59	−0.59
cyan	0.0	1.0	1.0	0.7	−0.7	0.3
red	1.0	0.0	0.0	0.3	0.7	−0.3
magenta	1.0	0.0	1.0	0.41	0.59	0.59
yellow	1.0	1.0	0.0	0.89	0.11	−0.89

cables to receive or print is an annoyance. The low-cost interface, however, provides a quick, easy, and cheap way to enter the exciting world of slow-scan television. Stay tuned next month when I describe how to build the high performance interface! 73

Table 3. Parts list for Low Cost interface

Part. No.	Description	Quantity	Price
C1,C2	100 µF electrolytic, 10 V	2	@ .19
C3	0.1 µF disc ceramic		.15
C4	0.01 µF mylar		.11
C5	0.001 µF mylar		.06
C6	0.033 µF mylar		.11
D1,D2	1N4001	2	@ .10
J1	DB-25S connector to modem port		.79
P1	DB-25P connector to printer port		.75
Q1	2N3904 or similar		.12
R1,R2	4.7 k	2	@ .06
R3	10 k trim pot		.89
R4	22 k		.06
U1	NE 565, phase-locked loop		.99
U2	CD 4013, dual type D flip flop		.29
	perfboard (RS part 276-150)		.99
	two 14 pin IC sockets	2	@ .39
	Approximate total		$7.00

Prices shown are from a typical mail-order catalog, except where a Radio Shack (RS) part number is listed.

References

[1]Edwards, Jon R., Robinson, Phillip, and McLaughlin, Brenda, "The Atari 520ST." *BYTE*, January 1986, page 84.

[2]Robinson, Phillip, and Edwards, Jon R., "The Atari 1040ST." *BYTE*, March 1986, page 84.

[3]Menconi, Dave, "The Atari 1040ST." *BYTE*, February 1987, page 231.

[4]Suding, Robert WØLMD, "8 and 12 second single-frame color SSTV." *The Best of A5—Slow Scan Television*, page 34. [Reprint booklet number 103 from ESF Copy Services, 4011 Clearview Drive, Cedar Falls IA 50613. $10 plus $1 postage.] Suding formats are not commonly used now.

[5]Robot Research, Inc., *Instruction Book—Model 1200C. Section Nine, "Technical Description." Manual is available separately for $25 from Robot Research, Inc., 5636 Ruffin Road, San Diego CA 92123. Tel. (619) 279-9430. Essentially the same information is in "Upgrade Your Robot 400 SSTV Converter," The Best of A5—Robot 400 Mods*, page 41. ESF reprint booklet 110. Same price as above.

Nets, Newsletters, and Magazines

The **International Visual Communication Association (IVCA)** has four weekly SSTV nets:

North American	Sat. 1500 UTC, 14.230 MHz
South American	Wed. 2300 UTC, 14.236 MHz
European	Sat. 1300 UTC, 14.233 MHz
South Pacific	Sun. 0400 UTC, 14.247 MHz

Another SSTV net, **The Slow Scan TV Network**, meets on Saturdays at 1800 UTC, also on 14.230 MHz. This one tends to have fewer pictures and more technical discussions.

The Atari Microcomputer Network meets Sundays at 1600 UTC on 14.325 MHz. This is a good source of information on ham applications for Atari computers. The group also publishes a newsletter called *Ad Astra*. The cost is $15 US or $18 CDN for six issues per year. Those outside US or Canada should add an extra $5 for additional postage. The editor is Gil Frederick VE4AG, 130 Maureen Street, Winnipeg, Manitoba R3K 1M2 CANADA.

The **United States ATV Society (USATVS)** publishes *The Spec-Com Journal*. This is primarily oriented toward fast-scan TV, but there is usually some mention of SSTV. Cost is $20 for six issues per year. Add an additional $5 for mailing to Canada and Mexico, and $10 for other countries. A net is held each Tuesday night at 2000 Eastern time on 3.871 MHz. The Spec-Com Journal, P.O. Box H, Lowden IA 52255-0408.

The **British Amateur Television Club (BATC)** publishes the quarterly *CQ-TV* magazine. Annual membership is £6. For a membership application, send an SASE to Dave Lawton GØANO, 'Grenehurst,' Pinewood Road, High Wycombe, Bucks HP12 4DD ENGLAND. The US representative is Wyman Research, Inc., R.R. #1 Box 95, Waldron IN 46182. Write for information about current rates in $ US.

An announcement of a new magazine appeared just as I was putting the finishing touches on this article: *Amateur Television Quarterly*, 1545 Lee St., Suite 73, Des Plaines IL 60018. A subscription costs $15 per year. (Add an additional $5 for postage to Canada or $10 for other countries.)

ASTUR has a newsletter which is available only on disks. Cost is two disks (one will be returned) and a few IRCs. ASTUR (Atari ST Users on Radio), GEERAERT Michel, W. Elsschotlann 21, B-8460 Koksijde, Belgium.

Number 26 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8½" x 11") sheet of paper. You may also upload a listing as E-mail to Sysop to the 73 BBS (1200 baud, 8 data bits, no parity, 1 stop bit, PH:603-525-4438). Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Thank you for your cooperation.

I am looking for accessories for my Yaesu FT-101Z such as external VFO, speaker, etc. Persons with anything for sale for the 101Z please write or call with description, condition and price. Also, need any technical information for the Tandy Model 600 laptop computer such as Memory Map, how to access the serial port from BASIC, use of the external disk drive port, and how to use MS-DOS/PC-DOS DEBUG to write library routines for the Model 600 (an 8088 machine like the IBM.) Contact: *Heyward Bozard, Jr. N4VFK, 234 Pinehill Road, N.W., Orangeburg SC 29115, (803) 536-0720/534-5350 (BBS). Compuserve 70270,530/GEnie HBOZARD.*

Wanted: Assembly sheets, parts list, schematics and instructions for Conar Model 400 transmitter. Purchased through National Radio Institute. Will pay copying and mailing cost.
Charles Hall, 495 West 19th, Russellville AR 72801.

I am researching a book on the life and times of Arthur Godfrey. I understand Mr. Godfrey had a very early, unusual call sign. Can anyone tell me what it was? Thank you. Contact: *Lee R. Munsick, 20 Harriet Drive, Whippany NJ 07981-1906*.

I am in need of schematic diagrams of a 150 watt generic switching type power supply used in a IBM XT clone, and also of a 2400 baud generic internal modem (which says BDP, Inc. or Best Data Products as a possible company name on it). Contact: *Marvin Moss W4UXJ, Box 28601, Atlanta GA 30358.*

I need an operating manual and schematic for a Yaesu FT207R. I will pay all associated costs for a copy, or I will copy and return the original. Thank you. Contact: *Don Richmond, PO Box 153, Talcott WV 24981.*

Needed: A schematic and manual for a Hallicrafters Model S-38C. Also, any updates on the ICOM IC-22S, A-B switch and the 145 MZ MOD. I will pay for copying and handling. Contact: *Ted Jenson KE6WF, HCR 58 Box 7-A, Spooner WI 54801.*

Help me please!. . .I need a service manual and diagram for my Atlas 350 XL Transceiver. I will pay for copy. Hoping for your answer as soon as possible. Thank you. Contact: *Paulo Cesar dos Santos PP2 ZD, Rua Osmundo Rodrigues da Cunha,, No. 605, Araguari MINAS GERAIS 38440, Brazil.*

I am in the process of restoring two old Edgecom radios series 3000, and an FMS 24 and FMS 25. I need any service information on these two units and parts descriptions. Contact: *Mike Herman KC9NF, 1549 N. Cicero Ave., Chicago IL 60651, (312) 276-6688 days.*

73 Review *by Pete Putman KT2B*

Mirage D15 70cm Amp

Boost your HT up to mobile power.

Mirage, Inc.
PO Box 1000
Morgan Hill, CA 95037
Price Class: $155

Mirage has added a new "brick" in its extensive line of solid-state power amplifiers. The D15 is intended for general use in the 70cm (420–450 MHz) band and is class AB1 linear biased to facilitate FM, SSB, CW, and even ATV operation.

What makes this particular design different is its simplicity, made possible by the use of a Toshiba S-AU4 power module instead of discrete transistors. The circuit board layout is simplified considerably. RF-sensed keying is used for TX/RX operation, but there is no provision for hard keying. A potentiometer is accessible through the side panel to set the drop-out delay in the SSB mode, while drop-out is instantaneous in the FM mode.

The heat sink and chassis are similar to the B22 and C22 series amplifiers, except that a new slotted cover is used for better cooling. Front panel controls are POWER ON/OFF and SSB/FM MODE. Two LEDs indicate when the unit is in line and when it's keyed up. Incidentally, the D15 does not use an antenna relay, relying instead on diode switching. This makes a lot of sense at this frequency, and the "clunk" of relay contacts pulling in isn't missed.

432.000 MHz		446.000 MHz	
IN	OUT	IN	OUT
0.5W	0*	0.5W	2W
0.65W	2W	0.65W	4W
0.7W	4W	0.7W	5W
0.8W	6W	0.8W	8W
0.9W	8W	0.9W	10W
1W	10W	1W	13W
1.5W	15W	1.5W	17W
2W	18W@3.0A	2W	18W@3.4A

*There is a sharp "knee" on the 432 range as the power rises from little or no output and quickly soars to 4–5 Watts output. In both cases, the amplifier becomes saturated with 2 Watts of drive.

Table 1. Power input vs. output for the Mirage D15 amplifier.

Mirage states that the amplifier will develop over 15 Watts output when fully saturated with 2 Watts of drive, and that the insertion loss is less than 1.5 dB. (The D15 has no internal preamplifier.) According to the manual, as little as .25 Watts will result in 6 Watts output across the 70cm band, so the D15 would seem to be ideal for hand-held users and ATV enthusiasts with 1 to 2 Watts output available.

Performance

The Mirage D15 was tested with a variable 70cm RF source using two Bird Model 43 meters—one at the input and one at the output. A Termaline resistor was used to terminate the D15. Two 50Ω attenuators were used before the amplifier to ensure linear power output from the 70cm source. Measurements were made at 432.000 MHz and at 446.000 MHz, covering the weak signal, ATV, and FM segments of the 70cm band. See Table 1.

Conclusions

The D15 is a well built amplifier that essentially meets the published specifications for all-mode operation. The workmanship is of excellent quality. The most likely users of this product would appear to be hand-held transceiver owners looking for a bit more power from home or the car, and ATV operators typically equipped with QRP transmitters. While Mirage claims full rated output with an intermittent duty cycle and no cycle times are claimed, I found the output fairly stable during a 3 minute key-up test into a 50Ω load. 73

Number 14 on your Feedback card

PACKET TALK

Latest in Digital Hamming

Brian Lloyd WB6RQN
5712 Stillwell Road
Rockville MD 20851

Apologies

I recently spoke with Tom Moulton W2VY of the Radio Amateur Telecommunications Society (RATS) about my article on networking (pp. 60-62) in the October packet issue of *73*. Tom is the author of the ROSE networking package. He spotted some errors and unclear statements in the article.

First, the ROSE packet switch does not contain an implementation of the OSI transport protocol TP1. Second, the statement, "ROSE can't communicate with NET/ROM, NET/ROM can't communicate with TexNet, and TexNet can't communicate with ROSE," is incorrect. Although they can't intercommunicate on the network level, all these protocols can indeed communicate at the AX.25 level. Users can manually set up a path involving all of these different types of network node as long as they set up the path like KA-Node: by issuing a connect command at each point along the way. Such a network can't switch packets between the different networks automatically.

If you're interested in the ROSE packet switch, and you want more information about it, contact Tom Moulton W2VY at *RATS, 206 North Vivyen Street, Bergenfield, New Jersey 07621; (201) 387-8896.*

A Disturbance in the Ether

Over the past two years many packet radio enthusiasts have had to deal with nasty messages, excessive QRM, and verbal abuse. The complaint? "You (fill in the blank—TCPers, NET-ROMers, TEXneters, etc.) are ruining packet radio for us 'legitimate' users." I have also heard, "My digipeater/NET-ROM is for legitimate packet radio use—not for TCP/IP." How about this one, "That BBS is making it so that I can't have a QSO with Fred (or Jim, or whoever). That *!—&$% BBS owner ought to get his own frequency and quit messing up ours." My personal favorite is, "You can't legally send TCP/IP over the air because it isn't AX.25 and the FCC regs only allow AX.25 packets on the air."

No, It's Not Illegal!

There are really three problems: people who like to monitor everything on the channel and who don't like all the binary "garbage" from the networking protocols; too many people on one frequency; and poor frequency sharing. The first problem turns out to be an oversight on the part of the people who wrote the firmware for early TNCs. Every AX.25 packet contains a field called the Protocol IDentifier (PID). This tells the receiver what kind of data is contained in the packet.

In the early days of packet, everything was sent with the same PID (hex value F0) indicating that the packet contained ASCII text. NET/ROM, TEXnet, TCP/IP, ROSE, and text all use different PID values to differentiate between them. These PID values are part of the AX.25 specification. The monitor mode of many TNCs ignores the content of the PID field, so if you turn your monitor on, you see garbage on the screen or on the printer. The solution is to get a later version of firmware for your TNC or get a new TNC.

This also touches on the complaint that use of TCP/IP, NET/ROM, TEXnet, ROSE, or any other networking or special protocol is unlawful. Not true! Each of the above mentioned protocols uses a technique called encapsulation, i.e., every TCP, NET/ROM, TEXnet, or ROSE transmission is completely contained in a perfectly valid AX.25 frame. All of these protocols are perfectly valid and legal in an amateur packet radio environment, on HF or VHF.

To go one step further, the FCC regulations do not even require an amateur station to send data using AX.25. They only require that the operator maintain a written description of the modulation and encoding techniques used at the station, and that the encoding/transmission method be used to enhance communications and not be intended to prevent others from receiving and decoding the transmissions.

Frequency Crowding

In populated areas, too many people may be on one frequency. A 1200 baud channel can handle only about 700-800 bauds average throughput. When you have several people typing to one another, the channel can handle many users before it reaches saturation, but as you throw in a computer that can type faster than a human, you begin to see problems with channel capacity. The BBS is a perfect example of this.

The answer? Provide more frequencies to divide the load and improve channel sharing. There is a simple reason why most people do not want to move to a different frequency: without a packet switch or BBS on the new frequency, they can't reach the rest of the world from there. On the other hand, trying to cram all the users in one area onto one or two frequencies is pretty crazy, too. Instead of putting up more digipeaters, it would be better to spend the time and money putting up duplex digipeaters (dual-frequency, real-time, digital repeaters) and cross-band packet switches.

Obviously, more frequencies will help eliminate overcrowding. There are LOTS of frequencies available for packet. Six meters, 220 MHz, and 70cm (430-450 MHz) are grossly underused. 33cm (902-928 MHz) is virtually unused. 23cm (1.2 GHz) is also underused AND it is one of the bands where Novices can operate.

Efficient Use of Frequencies

Surprisingly, file transfers and BBS operation don't have to monopolize a frequency. Several years ago, I set up three stations on 220. I set station A transmitting a file to station B, B sending a file to C, and C sending a file to A. Here were three stations all engaged in file transfers simultaneously. All three file transfers proceeded concurrently without a hitch. The final result was a channel throughput of about 800 bits per second, and a retry/retransmission rate of about 5%. How did I do it?

The first thing I did to improve performance was to use a duplex digipeater (input on 222.06 and retransmit on 223.66). With a duplex digipeater, there was no digipeater delay, so all transfers proceeded at full speed. The duplex digipeater also made it possible for all three stations to hear one another. This reduced collisions at the digipeater, which meant fewer retransmissions.

Next I took advantage of p-persistent CSMA, using the persist and slottime commands in my TNC, now a standard part of all Kantronics and AEA TNCs. With p-persistent CSMA I was able to greatly reduce the number of collisions caused by two or more stations trying to transmit at the same time (a situation I guaranteed by having several file transfers going at once).

The third thing I did was to use TCP/IP. TCP does several things that AX.25 does not. First, TCP measures the time it takes to get an ACK back for every packet it sends. It keeps a running tally of this round-trip time and sets the retransmission timer (FRACK in AX.25 parlance) to twice the average round-trip time. If there are fewer users and the channel loading is light, the round-trip time is short. If there are many users, or the channel loading is heavy, the round-trip time is much longer. The net result is that TCP does not resend packets unnecessarily.

Another feature of TCP is something called backoff. Every time TCP must resend the same packet, it waits longer. This results in the channel becoming quieter very quickly when there are lots of collisions and lots of lost packets.

Just for fun, I tried the same experiment again and tried establishing an AX.25 connection on the same channel. The file transfers proceeded as before, but the AX.25 station could not keep from timing out and eventually breaking the connection.

Making AX.25 More Efficient

There are some things that you can do to make your AX.25 operations more efficient and to make your station share the channel more efficiently. First, if your station supports p-persistent CSMA (that is, if your TNC has the persist and slottime commands), use it. Set DWAIT to 0 and set slottime and persist as I described in *73's* Packet issue (October 1989). Set MAXFRAME to 1 so that everybody gets a shot at the channel with every packet.

Lastly, set FRACK to a much bigger number so that your packets will have a chance to get to the receiver, and the ACK will have time to get back.

Consideration

The bottom line is this: packet radio is a hobby, and we owe it to each other to act in a courteous and thoughtful manner. Complaining without understanding will not get anyone anywhere. We owe it to each other to discuss issues rationally, without casting aspersions. 73

Number 15 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell PE KØOV
PO Box 2508
Fullerton CA 92633

T-Hunting Fun on Six Meters

Most hams in the USA think of 2 meter FM when someone brings up the subject of transmitter hunting. But there has been—and still is—lots of hunting excitement on other bands. In my Novice days, HF mobile was the rage, particularly 10 and 75 meter AM. So that's where hams did T-hunting. (Ask me about my trunk-mounted vibrator-powered DX-40 sometime.) Nowadays, inexpensive mobile and portable rigs are available for almost every band, so the possibilities for foxhunting fun are limitless.

Transmitter hunts have been a monthly activity of the Southern California Six Meter Club (SCSMC) for over three years, using 50.300 MHz FM, the local calling frequency. When SCSMC volunteered to put on the hunt for the 1989 ARRL Southwestern Division Convention, the SCSMC officers decided to have one of the three hidden transmitters be on 50.300. Substantial cash prizes created a sudden swelling of interest in 6 meters among serious southern California T-hunt competitors.

Because 6 meters is on the border between HF and VHF, it has some of the characteristics of each. The ground wave is very reliable for local QSOs, but the band opens for great DX via the F layer when sunspot activity goes up. Sporadic E propagation livens things up in the late spring and summer months. As a bonus, there is added excitement from aurora and meteor propagation at times.

Six meters is a very interesting band for transmitter hunting. It most closely resembles 10 meters, but reflections and multipath from hills and other features of the terrain are more likely. Reflections are much less prevalent than on 2 meters, however.

SCSMC holds hunts once a month on Saturday morning. The boundary is a 15 mile radius from the hilltop starting point. The hider must use a vertically polarized antenna and be on the air continuously. The team with lowest mileage from start to finish wins the hunt. Time is not a factor, which encourages safe driving and careful T-hunting techniques.

Despite these restrictions, hiders can still put on challenging hunts because of the varied urban and rural terrain in the area. Transmitting antennas are larger than for 2 meters, but hiders find clever ways to conceal them.

Rigs Are Plentiful

I can hear you saying, "How can I hunt on six? I've never even operated there." Too bad. You've missed some great fun. But you don't have to shell out big bucks to join the action. Look around—you may find you have most of your setup already.

Small battery-powered portable rigs, such as the Yaesu FT-690R, are popular for T-hunting, although the dynamic range of the S-meter is too wide for my taste. Older solid state rigs, such as the Yaesu FT-620, show up inexpensively at flea markets. They work on 12 volts and are easy to modify for an external S-meter, internal attenuator, and other goodies.

> **"Loop users frequently win the local hunts."**

Do you have a scanner in your shack? Chances are good that you can use it for T-hunting. Sony, Kenwood, AOR, Bearcat, Regency and Cobra have scanner models that receive at least part of the 6 meter band and work on internal batteries or an external 12 volt supply. Older commercial handie-talkies for 30–50 MHz by Motorola and RCA are inexpensive and convert readily to 6 meters.

As on other bands, there are several options for 6 meter hunting antennas. The one you choose depends on how you're searching (foot or vehicle), what you're hunting (horizontal or vertical, fixed or moving, weak or strong), and how much effort you want to expend in preparation.

Loops Are Easy

The simplest 6 meter RDF scheme is the loop antenna. As regular readers know, I dislike loops on other VHF bands, but small loops perform adequately on 6 meters when there is enough signal strength. Many hunters use them successfully. You can build a competitive loop in just a few minutes.

Photo A. Bob Hastings K6PHE uses a 6 meter T-hunting loop on his vehicle and on foot.

The loop design in Figure 1 comes from John Wendt WA6BFH. All you need is a 27½-inch piece of RG-11 75Ω coax, two PL-259 connectors, a UHF Tee connector, and adapters to get to your downlead.

Install PL-259 connectors on each end of the RG-11 coax piece, leaving the center conductor connection open on one end. Connect the PL-259's to the Tee to form the loop. Cut the jacket and braid of the RG-11 coax at the exact center (top of the loop), leaving a half-inch gap with the center conductor and dielectric intact.

Cover the gap with black electrical tape and hook the loop to the receiver with a suitable length of RG-58 or RG-8X coax. No tuning is necessary. You will get two sharp nulls (minimum signal points) looking through the loop, exactly 180 degrees apart. Signal peaks will be in the plane of the loop, at right angles to the nulls. The nulls give the most accurate line of bearing. When the signal is too weak to discern the nulls, use the peaks instead.

Mount the loop on a length of PVC pipe or a wooden broomhandle as in the photo. Hold it up over your head when taking bearings, keeping it as far away as possible from the vehicle to avoid distortion of the nulls. Power lines, metal fences, and the like can also cause bearing inaccuracies when they are near 6 meter loops, so stay away from them.

You can hold your loop out the window when mobile, but it's much better to provide a sturdy mount with a 360 degree indicator to give an accurate line of bearing for map plotting and triangulation. For best results in all weather, mount the mast through a hole in the car roof (see "Homing In" for July 1989).

As you close in on the fox, the signal will get so strong that it will fill in the nulls, so you'll need an internal or external RF attenuator capable of at least 80 dB gain reduction ahead of the receiver (see "Homing In" for March 1989).

Ahead or Behind?

I have previously pointed out that the biggest disadvantage of simple loops is their bidirectional patterns. You have to carefully plot bearings and "circle in" on the hidden transmitter with a dual-null antenna, or else you could find yourself going away from the transmitter instead of toward it.

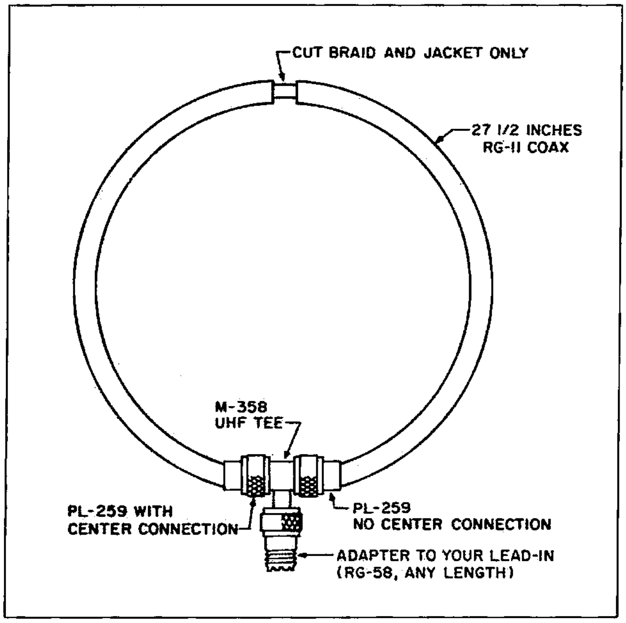


Figure 1. A simple loop for 6 meters.

For mobile hunting, there is a convenient way to resolve the figure-8 problem. A whip antenna mounted on the fender near a corner of the vehicle has a pattern that is unidirectional on some ham bands. Mount a quarter-wave whip on the left rear deck and you'll find that S-meter readings are higher when the hidden T is in front of you and somewhat to the right. The directional lobe is broad, but it's good enough to tell which of the two loop nulls to follow.

This trick may seem crude, but it works quite well for 6 and 10 meters on most vehicles. You'll want a 6 meter whip on your car anyway, so you can talk to the hider. This puts it to another good use. Use a coax switch for rapid selection of the loop or the whip during the hunt.

By the way, standard Hustler HF mobile masts (except for the MO-4) are 56 inches long (without resonators), so they work fine as quarter-wave mobile verticals on six. Another good choice is the Larsen 2 meter ⅝-wavelength magnetic mount antenna. The whip is a quarter wavelength on six. It matches quite well without modification at 50.3 MHz.

It's possible to add a "sense" antenna and phase shift network to a loop to resolve the directional ambiguity. The surplus AT-249/GRD and AT-339/PRC units are ready-made RDF antennas incorporating this technique. Both are rugged, easy to use, and cover 47 to 55.4 MHz by design. Unfortunately, they are becoming difficult to locate since T-hunters have discovered their usefulness and snapped them up.

Beginner's Luck?

Despite its lack of sophistication, the simple loop does the job on 6 meters. Loop users frequently win the local hunts. Kevin Kelly N6QAB, an experienced 2 meter hunter, came out on his first 6 meter hunt recently. He used the WA6BFH loop, a whip, a scanner with S-meter, and an external attenuator. His 2 meter hunting experience paid off, because he ended up with low mileage that day.

A loop is by no means the best 6 meter hunting antenna. The small capture area of a fractional wavelength loop makes it much less sensitive than larger antennas. This by itself is not usually a severe problem, because the SCSMC rules require that the hidden T provide a signal that is copyable on loop antennas at the starting point. But if your receiver isn't "hot," you'll want to add a preamp.

There are other good ways to hunt on 6 meters, but there is no more space this month. Next time, I'll tell you how quads and homing RDFs can help you win 6 meter hunts. Thanks to Bob Hastings K6PHE, Gracie Hastings N6FSL, Wil Anderson AA6DD, John Wendt WA6BFH, and all the other SCSMC hunters for their technical assistance and for helping to promote T-hunting on 6 meters. ■

QRP

Low Power Operation

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Massillon OH 44646

More on Direct Conversion

Although most selectivity in a DC receiver is done in the audio chain, a good solid front end helps. A single tuned front end improves operation a great deal.

A double tuned circuit is even better. Look at the circuits in Figure 1, created by Denton Bramwell K7OWJ, for each one. Values are given for 30 and 40 meters. All the coils are wound with #22 gauge wire. Be sure the leads are long enough to solder to the board. Since this is not going to be a step-by-step construction project, there is no large schematic; rather, what we have are some good add-on circuits.

Radio Shack sells a perfboard with a copper ground plane, ideal for building small receivers or transmitters. It's easy to cut and work with. I've been using it for a good long time, with excellent results.

Product Detection

The input circuit really helps cut down AM detection. It's not a cure-all, but it helps a lot. One of the best places to stop AM detection is in the mixer or product detector. I built a small DC receiver using a 40673 MOSFET. Worked great! The only trouble was that, after dark, when the shortwave broadcast stations came on. Picked them up rather well, all of them, all at the same time. To make matters worse, the circuit was built for 40 meters—broadcast station heaven! So, for only the simplest emergency or portable gear, leave the 40673 in the parts bin. You'll be glad you did.

A singly balanced product detector is the next best. However, you don't see too much of this type of detector around. In most cases, you'll need to use either a matched pair of JFETs or an IC, such as a RCA CA3028A.

You can obtain the best results with a doubly balanced product detector. The detector can be either passive, using diodes, or active, using either transistors or an IC chip. The most common doubly balanced product detector uses hot-carrier diodes. However, for us home-brewers, we can get good results with high speed switching diodes, such as the 1N914s. It's best to get a matching set of diodes. This is easily done with a VOM.

When using a passive detector, we have a conversion loss. Likewise, using an active detector, you may obtain some gain. A diode-ring detector above 30 meters requires an RF amplifier ahead of the detector. Figure 2 shows a working diode-ring detector. In building this, be sure to watch the phasing of the coils. Winding these critters and getting them correct the first time is fun.

If you're not really up to winding a diode-ring product detector, and I can't really blame you, a commercial unit, the Mini Circuits Lab SBL-1 DBM is available. It's not cheap, but it's easy to work with. Radio Kit in Pelham NH (603-635-2235) sells them. Also ask for a catalog from the Small Parts Center, 6818 Meese Dr., Lansing, Michigan, 48911. They also sell them.

A newer circuit on the market, the Signetics NE602, has given rise to a host of DC receivers. This chip, also available from the Small Parts Center, has an on-board oscillator as well as a doubly balanced mixer and voltage regulator. Most importantly, with this chip the input voltage MUST be under 9 volts. Any more than that, and POOF! I know. In the months that follow, I'll have some simple circuits using the NE602. Keep watching.

> ***"One of the best places to stop AM detection is in the mixer or product detector."***

Audio Chain and Preamp

After the product detector, we start working with the audio chain. While some people go directly to a high gain audio amplifier, I prefer to add some passive audio filters. I've used old 88 mH telephone coils for this and they work quite well. Only trouble with these, they are much too big for most portable receivers. You can use smaller coils, but they're harder to come by. The 88 mH coils are hamfest specials.

One of the best reasons for using a passive filter is power transfer from the detector to the active audio stages. Also, the filter removes most of the high frequency audio (2–15 kHz) from the high gain audio chain. If you've ever used a pair of those lightweight walk-thing headphones and tuned into a 15 kHz beat note, you will be able to appreciate this filter.

A low noise preamplifier sometimes follows the passive filter. While you can use junk box transistors, and I've used about everything you can think of, a low noise transistor works best.

From the preamplifer, we go to an active audio filter. I don't care for my audio to be super-filtered, so I'm not really picky about how many stages of filters I use. The most common circuit uses a LM324 op amp. I'll have a simple circuit for that in a later column, along with the final audio amplifier stage.

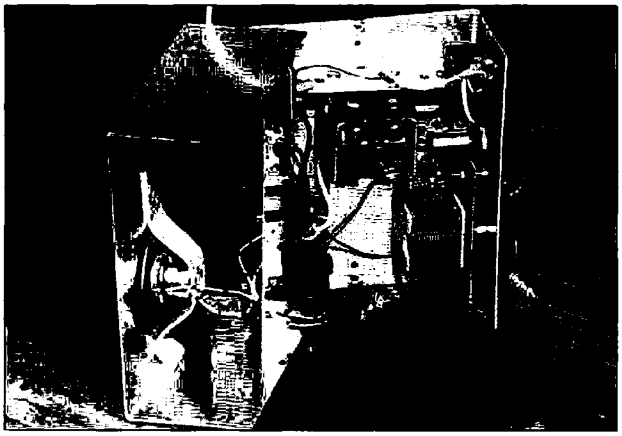

Photo A. A small home-brewed DC receiver.

Pulsed Battery Charger

The August project, the pulsed battery charger, did generate quite a lot of mail and several phone calls. First things first: There are some errors in the schematic. The blocking diode wasn't labeled. It can be a 1N4001 or any other junk box diode rated at 1 amp or more.

Of course, if you use the LM350 with its 5 amp current rating, you'll need a larger diode also. Radio Shack sells a 3 amp diode and, I think, a 6 amp diode. If you plan to use the LM350, you'll need to increase the current from the transformer and diode bridge setup. You'll also need a larger transformer to handle the extra current. Junk box!

The unmarked resistor on the collector of the transistor is 220Ω. The transistor should be a 2N2222 or equal. And last but not least, the 2.2kΩ resistor is shown as a trimmer, which it is NOT. Use a 2.2kΩ resistor and forget about the wiper connection.

Gell Cell Batteries

Aside from the critters making a living in my schematics, most of the phone calls and letters asked about those crazy gelled batteries we all find at the hamfests. I did some digging and came up with a charging manual from the Globe Battery Division on Gel/Cell™ batteries.

According to Globe, the gelled battery likes to be charged using a constant voltage-limited current charging technique. There are also two types of batteries, "A" and "B." Type "A" batteries are used for standby applications. Expect a life of 100 cycles. Applications include intrusion alarms, fire and smoke detectors, uninterruptible power systems, emergency lighting, and computer memory standby power.

Type "B" batteries are for deep-cycle use. According to Globe, a new type "B" battery has an initial capacity of 80–90 percent. After 30–40 complete charge cycles, it reaches its nominal rated capacity. After 200 cycles, the capacity slowly drops. With only minor discharges (40% or less of capacity), you may get up to 1000 cycles. Typical applica-

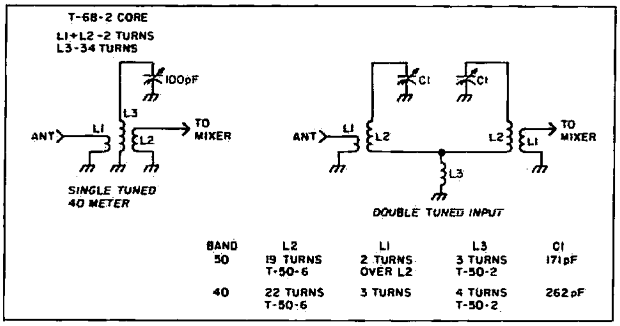

Figure 1. Tuned circuits for DC receivers.

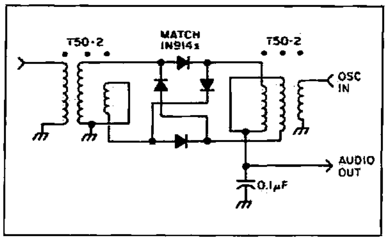

Figure 2. Passive diode product detector. Use matched 1N914s.

tions include TV and radios, video tape recorders, computers, and tools.

As far as I've been able to determine, a battery is type "A" or "B" depending on how you use it. In standby systems, the battery becomes a type "A" battery. If you use the same battery for deep-cycle, it becomes a type "B" battery.

The open circuit voltage for a fully charged gelled battery is 2.12 volts. Of course, the voltage is higher when you first remove the battery from the charger. For a fully discharged battery, the terminal voltage should be 1.75 volts after steadily drawing the current it's rated for after a 20-hour period. You can charge a gel-cell at 2–3 times the rated current. For example, you can charge a 6 volt, 4.5 Ah battery at 7.2 volts (2.4 volts per cell), that is rated at a discharge current of 300 mA, with the charge current limited to between 675 and 900 mA. The battery is fully charged once the charging current stabilizes at a low level for a few hours.

For standby applications in which the battery is operated with continuous charge, as in emergency lighting, for unattended charge a voltage of 2.25 to 2.30 is recommended. For a 6 volt battery this would be 6.75 to 6.9 volts.

For cycle use, optimum recharge time is obtained when a charge voltage of 2.4 volts per cell is used. Our 6 volt battery would require 7.2 volts (2.4 volts per cell x 3 cells). The battery is fully charged when the current drops to a low value. See the table. If you want to keep the battery on the charger, switch to the lower float voltage of 2.25 volts per cell.

Any Mods?

Since I'm not the only person picking up gelled batteries at the hamfests, I'll have more about these critters next month.

Still looking for mods for the Heath HW-9 for the third edition of the *Hot Water Handbook*. If I use them, you'll get a free copy of the book.

With the weather getting colder, now is a good time for some low-power fun. QRP—better living with less. ■

Battery Rated Capacity, Amps	Limit Initial Current, Amps	End of Charge Current, mA
0.9 to 1	0.15 to 0.20	10–20
1.5	0.23 to .30	20–40
2.0	0.30 to .40	20–40
2.6	0.40 to .50	30–60
4.5	0.70 to .90	50–100
6.0	0.90 to 1.20	60–120
7.5	1.1 to 1.5	80–160
20.0	3.0 to 4.0	100-300

Table 1. Capacity and initial current vs end of charge current for gelled batteries.

Number 17 on your Feedback card

HAMSATS

Amateur Radio Via Satellite

Andy MacAllister WA5ZIB
14714 Knightsway Drive
Houston TX 77083

It's Fixed!

The Mode S (70 cm uplink, 13cm downlink) transponder is finally working to specifications. Thanks to the efforts of Peter DB2OS, with the aid of ON6UG and G2BFO, the transponder passband can be commanded ON and the telemetry beacon OFF. That's the way it's supposed to work, but until early August it didn't.

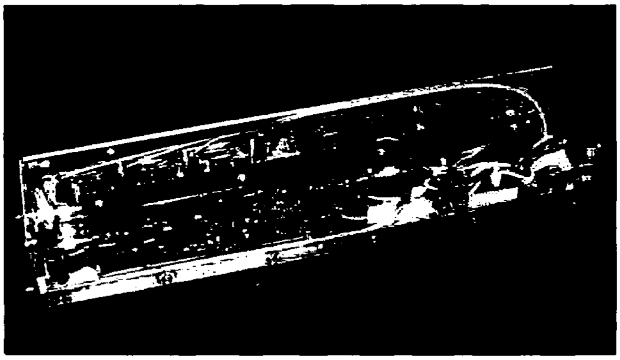

Photo A. The AMSAT-OSCAR-13 Mode S converter, now working well, is just over a foot long.

Mode S transponder designer and builder, Bill McCaa KØRZ, created the device so that either the beacon or the passband could be activated, but not both at the same time. The transponder passband is enabled by a logic line that comes from the satellite's IHU (Internal Housekeeping Unit computer). If the telemetry beacon is on, then the logic line is supposed to turn it off and activate a transistor in the passband electronics.

Until now it wasn't happening that way. Commands were sent with no effect. The beacon signal would stay on and the passband would stay off. As a result, 20 dB more uplink power than anticipated was required to make Mode S contacts. The signals from the ground had to force their way through the deactivated transistor in the passband electronics. Where 1000 watts erp (effective radiated power) might have been fine according to the original design, it actually required more like 100,000 watts erp. Many contacts were made with much less uplink power, but the received downlink was always weak.

A Simple Matter of Timing

A series of tests were performed by Peter DB2OS. Peter is one of the OSCAR 13 ground control stations. By changing the timing of the system commands embedded in the onboard software, Peter was able to achieve a combination that brought the satellite's Mode S transponder passband up while bringing down the telemetry beacon. ON6UG and G2BFO listened to the Mode S downlink frequencies during the tests to keep Peter instantly informed on the effects of his software modifications. The results were dramatic. Hams using less than 100 watts erp CW were able to make quality contacts through the Mode S passband. Thanks to the efforts of Peter and other tireless supporters, we now have a fully functional microwave transponder on an amateur radio satellite.

An Extra "Feature"

While equipment users call glitches in computer systems "bugs," programmers would rather refer to them as "features," not all of which are desirable. When the Mode S passband came online in August, unexpected signals were heard. Apparently a portion of the Mode B uplink passband also appears in the Mode S downlink.

The normal Mode S uplink range is from 435.602 MHz to 435.638 MHz. The corresponding noninverting downlink is from 2400.711 MHz to 2400.747 MHz. Mode B uplink signals on frequencies between 435.480 MHz and

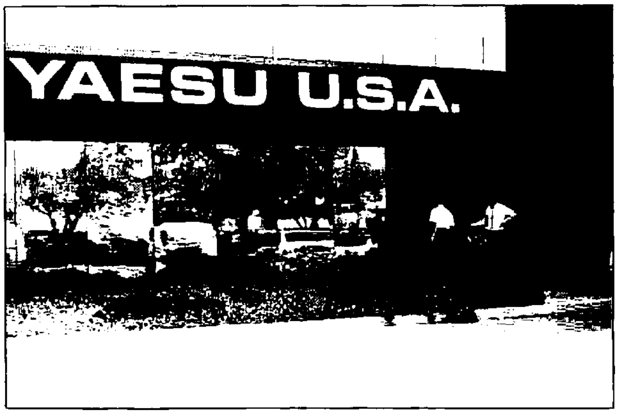

Photo B. The Yaesu USA building in Cerritos, California.

435.516 MHz are also being downlinked on 13 cm in the same band segment with Mode S operators.

Mode S enthusiasts have found this feature an asset with few drawbacks. On the plus side, they can use the Mode B frequencies for uplinking, and be heard on both S and B downlinks. This intrigued Mode B users. The downlinked 2 meter signals are heard on lower sideband, since the B passband is inverting while Mode S is not. The B user can then reconfigure his uplink signals to match the Mode S user and make contact. The S user can then tell the B operator the level of copy on 2400 MHz thus publicizing the existence of an operational Mode S transponder passband.

The downside of the multiple uplink/downlink feature is the competition for space within the rather narrow 40 kHz Mode S passband. The B frequencies which cross to Mode S are very popular. Finding an open spot to operate within the 2.4 GHz downlink can be a problem.

Mode S is a mode that will be with the amateur satellite program as long as we have access to the 13cm band. The Phase 4 geostationary hamsat will use the band extensively. The transponder on OSCAR 13 is working extremely well and offers a great opportunity to experiment, have a lot of fun, and make a lot of contacts. Give it a try!

The "ZRO" Test

The K2ZRO Memorial Station Engineering Award Program, a contest focusing on operating skill and equipment performance, was started a few years ago via AMSAT-OSCAR-10. Named in honor of Kaz Deskur K2ZRO, designer of the Satellite OSCAR tracking

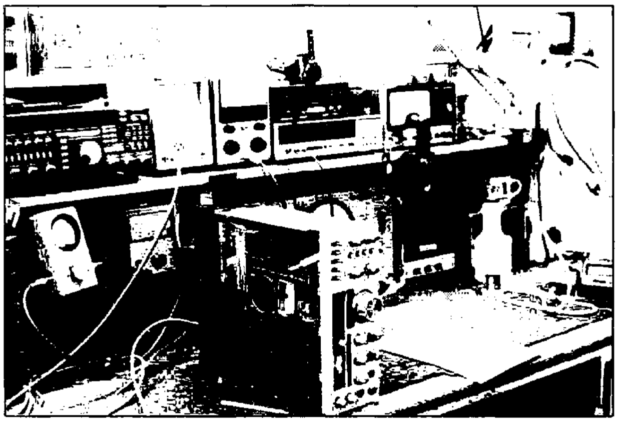

Photo C. One of the many benches for radio repair at Yaesu USA in California.

A-O-13 Mode B ZRO Test Schedule

downlink signals on 145.840 MHz

Date	Time
Nov. 25, 1989	2030 UTC
Dec. 2, 1989	1240 UTC
Dec. 16, 1989	2000 UTC
Dec. 30, 1989	1600 UTC
Jan. 13, 1990	1200 UTC
Jan. 20, 1990	1530 UTC

calculator and long-time AMSAT supporter, the program tests the listening capabilities of individuals with the best equipment they can bring together for amateur satellite operation.

Since the attitude of OSCAR-10 is no longer controllable, OSCAR-13 is used for the tests. A control station sends and repeats numeric code groups through the satellite's transponder at gradually reduced power levels, starting at a level equal to the general beacon. Participants monitor and record the numbers until they have either copied the 10 wpm CW down to level "Z9" (27 dB below the beacon), or until they can no longer hear the control station's signals.

Those who can hear the satellite's beacon will also be able to hear level "Z0" of the test and qualify for the basic award. The certificate is available through AMSAT-NA. For free verification reports to qualify numbers copied, send an SASE to my address above. The fun comes from upgrading station performance and then pursuing endorsement stickers for the lower power levels. The goal is to encourage stations to improve their downlink reception. Those who hear poorly tend to resort to unnecessary uplink excesses which drain the satellite's batteries and desensitize the satellite transponder for low-power operators.

The Table shows the dates and times of ZRO Tests scheduled for the end of this year and into 1990. They were chosen for coverage, convenience, and optimum operating conditions. The downlink frequency via the Mode B transponder is 145.940 MHz. Other tests will be set up for Mode L with a downlink of 435.945 MHz. You can find the dates and times on the AMSAT HF Nets.

Only a handful of stations have copied and reported accurate "Z9" reception via Mode B. The erp from the Test Control Station is usually less than ONE watt at the "Z9" level. Only superb attention to detail, care in assembling their stations, and a quiet RF environment will allow this kind of receive performance.

But don't wait until you have the "perfect" station to participate. Reports have been received from enthusiasts using many types and sizes of antennas. One operator was on a boat with a 2 meter dipole. Another was in a car with a magmount. Others using simple 4-element yagi antennas, no preamps, and stock radios without exotic filters, have copied signals down to 15 dB below the beacon.

Next time a ZRO Test is on, listen. Just how good is your 2 meter station? How does it stack up with other satellite enthusiasts?

A Look at Yaesu

I was in California recently, at the invitation of Yaesu USA, to participate on their advisory council. As I escaped the incredible traffic of Los Angeles and headed for their location in Cerritos, California, the satellite antennas, aimed at the sky, caught my eye before anything else. A pair of KLM crossed yagis were silently tracking the passage of OSCAR-13. The mirrored front of the 17,000 square foot facility, with over 40 employees, soon blocked my view, but I didn't mind—the new FT-736R, auto-tracking system and RF Concepts amplifier couldn't be far away. Within minutes I was investigating the gear and checking out the orbital predictions.

Chip Margelli K7JA, Yaesu's Vice President of Customer Services, had been tracking the satellite. In addition to his fascination with DX, Chip had caught the hamsat bug. Earlier this year Chip traveled to MV Island between Finland and the Soviet Union to put a new country on the satellite.

Yaesu has been featuring satellite-oriented gear for many years. Prior to the FT-736R and FT-726R, older HF rigs sported optional transverters with extra positions on the band selector labeled SAT. 1, SAT. 2 and SAT.3. With the addition of an extra 10 meter receiver, the HF rig/transverter would become a complete full-duplex satellite station for Modes A (2 meters up and 10 meters down), B (70cm up and 2 meters down), and Mode J (2 meters up and 70cm down). The newer rigs represent the logical progression from years of experience with satellite earth-station functions.

A tour of the building proved fascinating. New rigs ready for shipment in the warehouse, carefully-labeled parts bins for rig repair, and well-organized lab-bench areas occupied most of the complex. Some offices and conference-room areas were on the second floor, but most of the activity was in the sales and customer service section. A new computerized system was being implemented for customer records and ordering information.

If you are in the Cerritos area, drop in. The satellite station is right up front and ready for contacts. 73

Number 18 on your Feedback card

LOOKING WEST

Bill Pasternak WA6ITF
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Saugus CA 91350

Thoughts of Dayton

I know it's strange to be writing about the 1989 Dayton Hamvention at this time of year, but then again, we're already more than halfway to the 1990 gathering. Just the other day I found myself writing a letter of confirmation to their program chairman to tell him I would be attending. The Dayton Hamvention is amateur radio's largest and most popular gathering, with well over 30,000 people attending this April event each year. Start making your plans for Dayton now—hotel rooms and plane seats get booked up early!

220 MHz—ICOM Says: Use It!

As far as new gear for the repeater user, my personal opinion is that ICOM stole the show at Dayton '89 with the introduction of the world's smallest full-feature 220 MHz handheld radio. The ultra tiny IC-3SAT weighs a mere 9.9 ounces and measures only 1.9" x 4.0" x 1.2", including its built-in 300 mAh, 7.2 volt battery. And when that power source is expended, you don't have to run to find a rapid charger. Simply connect one of several optional battery packs to the bottom of the transceiver and keep right on operating!

This mini-mite of the handhelds has features that will make you the envy of the local club. These include 48 fully programmable memory channels that store operating frequencies and other information required for repeater operation; a call-channel with the same features; a DTMF encoder for autopatching or control, with 10 DTMF code memory channels of up to 15 digits; receiver full scan, memory scan, memory skip and priority channel watch; up to five watts power out, using a specially designed ultra small high efficiency power module that requires only 13.7 volts DC; and an external power jack that doubles as a charger port for the internal battery.

It also has a feature never before found in a handheld: The IC-3SAT has a built-in clock that lets it double as an alarm clock! The radio can be pre-programmed to turn itself on and off at pre-programmed times to allow you to fall asleep listening in on a late-night QSO and to wake up to the chatter of drive-time, if you so desire!

Options include the UT-49 DTMF Decoder, UT-50 Tone Squelch Unit, and UT-51 programmable Tone Encoder. Availability through factory authorized ICOM dealers was late June. Regardless of what the FCC has in store for 1¼ meters, the amateur radio industry is keeping its commitment. ICOM is showing its commitment to the users of 220 with a new radio that can only be described as astounding for its size and performance.

There is now also a 2SAT and 4SAT available, for 2m and 440 MHz, respectively.

Looking Toward 1990

I have reason to believe that Hamvention '90 will have a new look to it. You might say a younger look because in 1990 the Hamvention hopes to attract some of the younger members of our "New World of Amateur Radio." To do it, they have turned to one of the stars of that show—an energetic 18-year-old college student from Southern California named Kelly Howard N6PNY. And it really does read like a movie script:

Scene 1. A Mexican restaurant in suburban Dayton. It was over dinner, before catching flights home, that Burt Hicks WB6MQV, Nathan Pyle KB6PLH, Kelly and myself joined the Hamvention team for an after-it's-all-over celebration dinner. Kelly struck up a conversation with a number of key Hamvention planners. Among them were General Chairman Bill McNabb WD8SAY, Assistant General Chairman (and 1990 General Chairman) Ed Hillman N8ALN, and DARA Youth Activities Director Terry Falknor N8EEO. Her subject was simple. She wanted to see more young adults in amateur radio, and the astute Miss Howard realized that the Dayton Hamvention is an event that can dazzle the most cynical teenager. It was time for the Hamvention to have a session specifically geared for young people, but not one run by an "old guard" type who is mostly interested in selling Morse code.

Who knows teens better then another teen?, argued Kelly. Her words found fertile soil. By the time Noel McKewon WB8QQC dragged us off to the airport, Kelly got *carte blanche* to help organize any youth activity for Dayton '90. As we made our rush to our respective airlines—she and Nathan on American to San Diego and Burt and me on TWA to Los Angeles—it was obvious that Kelly Howard N6PNY had some fascinating ideas on recruiting teens to amateur radio. Fade to black.

Scene 2. My den and office in Saugus. Kelly is now living in Los Angeles and getting ready to start college. This particular afternoon we are talking about Dayton weekend. It was her first and my 17th or 16th. She tells me what she wants to do at Hamvention '90. She wants to have a session where teens who are hams talk to teens who are interested in becoming hams. Where those with licenses and the ability to communicate with their peers give the hands-on experience of amateur radio to teens who know ham radio only as something that their dad or neighbor plays at as an old person's hobby. Kelly tells me young hams like herself can reach other teens and young adults. She says that it's important for her to try. So, I suggest that she tell this to the folks in Dayton and see what they say.

Scene 3. Dissolve to my living room. Sharon is watching TV. I'm reading a copy of another ham mag. A few minutes and two phone calls later, Kelly emerges from the office with the biggest smile across her face that I have ever seen. She sold her idea well enough to be asked to host the first-ever Dayton Hamvention Young People's Forum. And what will she present? Freezeframe and font over "To Be Continued."

Actually, she will be telling you that herself. I invited Kelly to be a guest writer for the next

Looking West column. In the meantime, those of you with youngsters from 9 to 19 might want to make plans to bring them with you to Hamvention '90. Kelly and her friends have a very special day planned. Who knows, after this session you may be arguing with your son or daughter over who's going get first dibs with the radio on weekends, or shelling out some extra bucks to buy your offspring an HT.

The Lights of the City

I really cannot end this month's column without a personal word of appreciation to the Dayton Amateur Radio Association and the Hamvention Committee. In April of this year they chose to honor me as the 1989 Radio Amateur of the Year. It was something that caught me completely by surprise, and it's an honor I will treasure to my dying day.

Some may view an award of this type as a measure of personal success. I look at it quite differently. To me, receiving an award—any award—means that you're making a valid contribution, and that you now have an even greater responsibility to continue and do even better so that you continue to deserve such an honor.

When I accepted the award, I asked everyone present to join me in dedicating it and the years ahead to the renewal of amateur radio—to the young and young of heart, who will pick up the banner of this great hobby and service, and carry it forth into the next century and beyond. Thanks to young, energetic and dedicated young hams like Kelly Howard N6PNY and Nathan Pyle KB6PLH, we are beginning to see a tiny bit of light at the end of a dark tunnel called apathy. There is still a long way to go.

As I close this month's *Looking West*, I ask that each of you join with me in this dedication, and that we direct our energies to bringing the youth of this nation to the hobby that we love. If we each "Elmer" into amateur radio only one new young ham, we can significantly boost our ranks—and give our nation a new base of potential engineers and technicians that it so badly needs.

Let's stop hoarding amateur radio as if it were some secret to be prized by the few and kept from the many. Let's open our doors to all who have the interest.

The 1990s will soon be with us and the day when Morse Code is King is dead. The new "Morse Key" is the hand-held most of us carry on our belts. The new long-wire is the rubber-ducky. The new DX is relayed by ham satellites in the sky. Some of us might even live long enough to hold a QSO through the first repeater on the moon. But only the young can make that happen, and the young will only come to amateur radio if they can bring their modern thinking with them. I for one say it's time to stop idolizing the traditions of yesterday and start building the traditions of the future. I say this because I love ham radio from the deepest reaches of my heart.

Thank you, Dayton, for making 1989 a year that will live with me into eternity. More important, thank you Dayton for recognizing that the future of amateur radio is with the young. You are doing more then your share. Let's hope other conventions and hamfests will follow your lead. It's time to tell the kids of the nation that we want them and that we care!...de WA6ITF

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A. Total No. Copies (Net Press Run)	66969	67000
B. Paid and/or Requested Circulation 1. Sales through dealers and carriers, street vendors and counter sales	17135	16800
2. Mail Subscription (Paid and/or requested)	28105	28000
C. Total Paid and/or Requested Circulation (Sum of 10B1 and 10B2)	45240	44800
D. Free Distribution by Mail, Carrier or Other Means Samples, Complimentary, and Other Free Copies	650	670
E. Total Distribution (Sum of C and D)	45890	45470
F. Copies Not Distributed 1. Office use, left over, unaccounted, spoiled after printing	979	1520
2. Return from News Agents	20120	20010
G. TOTAL (Sum of E, F1 and 2—should equal net press run shown in A)	66989	67000

11. I certify that the statements made by me above are correct and complete. Signature and Title of Editor, Publisher, Business Manager, or Owner

PS Form 3526, Dec. 1987 (See instructions on reverse)

Number 19 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. *Please send us your Special Event* two months in advance *of the issue you want it to appear in. For example, if you want it to appear in the June issue, we should receive it by March 31. Provide a clear, concise summary of the essential details about your Special Event.*

DEC 2-3

APACHE JUNCTION AZ The Superstition ARC 4th Annual Hamfest will be held at the P & M Rodeo Grounds Saturday from dawn to dusk, Sunday from dawn to noon. Talk-In: 147.12/Repeater. Contact *Bill or Marge Glaze, KA7SUF/K1YCZ (602) 832-3955.*

1st Saturday Every Month

LITTLETON CO The Denver W5YI VE Team holds exam sessions at 9 AM at the Bemis Library. Contact *Tony Marquette, (303) 773-2087 or Ken Chaffin, (303) 696-7046.*

SPECIAL EVENT STATIONS

DEC 2-3

SACRAMENTO CA The Sacramento ARC will operate Station W6AK from Sutter's Fort from 1730Z Saturday to 2330Z Sun- day to celebrate Sacramento's Sesquicentennial. Frequencies: SSB 14.300, 21.400, 28.450 (day); 3.962, 7.270, 14.300 (night). CW: 14.050. For QSL send SASE to *Sacramento ARC, P.O. Box 161903, Sacramento CA 95816.*

EVERGLADES NATIONAL PARK FL Station W4SVI will be operated at the Flamingo Camp Grounds by the Everglades ARC, from 1400 UTC Saturday until 1900 UTC Sunday, to celebrate the 42nd Anniversary of Everglades National Park. Frequencies: Phone: 7.230, 14.240, 21.330, 28.375; CW: 7.030, 14.030, 21.130. Send QSL and 2 units of postage for an unfolded certificate to *Everglades ARC, P.O. Box 113, Homestead FL 33090-0113.*

DEC 26-31

SAN BENITO TX The San Benito ARC will operate Station WA2VJL to celebrate the well deserved "R & R" of Santa and Rudolph in the Lower Rio Grande Valley of South Texas. Let the little ones wish Santa a safe trip home. Exchange local weather info and anything else. Frequencies: SSB 21.350 and 28.325. Time of operation will depend on band conditions, with (weekday) 1500-0200, and all day weekends. For certificate send 9 ½ x 11 with QSL to *Santa Claus, c/o San Benito ARC, P.O.Box 1382, San Benito TX 78586-1382.*

DEC 30-JAN 1

PASADENA CA The Relay Repeater ARC will operate KE6PE from the Wrigley Mansion to commemorate the 101th Anniversary of the Tournament of Roses. The station will operate from 1600Z-0400Z each day. Frequencies: 14.260, 21.335 and 28.450 Novice/Tech frequencies and/or QRM. For Certificate send QSL and 9 x 12 SASE to *Relay Repeater Club, P.O. Box 81, Arcadia CA 91006-5019*

ABOVE AND BEYOND

VHF and Above Operation

C.L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake
San Diego CA 92119

PLL Brick Oscillators

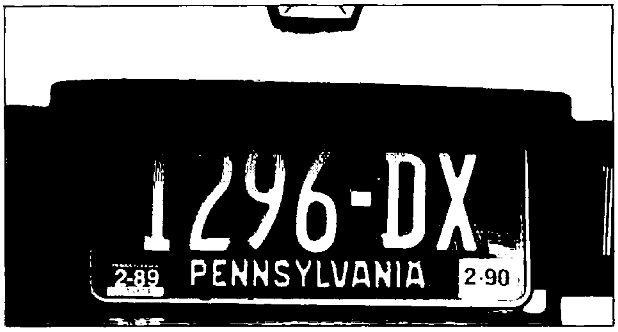
Not wishing to re-invent the wheel (and being lazy), I would like to introduce you to the "Brick," a phase locked local oscillator packaged in a small metal block housing about half the size of a small paving brick.

This surplus high-stability microwave oscillator is the same type used for narrowband FM and SSB contacts on 3, 5, and 10 GHz. For a 10 GHz preamplifier, see the August 1989 issue of *73*. This receiving low-noise amp with 18 dB gain also doubles as a transmitting amplifier with about +8 dBm output. This preamp and brick oscillator combination make a very simple microwave transceiving converter.

A simple, stable local oscillator (LO) is the key to operating on your chosen band. Even in some of the better kits for our microwave bands, the LOs lack stability and purity, both crucial items. You can build mixers and amps from surplus devices.

All the oscillators I've obtained over the years have been surplus items costing $20–50 each, depending on condition. Recently, I picked up some bricks from Alan Dickerson N5BXH, who obtained them from Collins Microwave sales in Richardson, Texas. Many years ago, I attended a microwave school at the same Collins plant, and spent my time off in their salvage store picking up my first brick. I had been using them commercially, but this was the first one I could experiment on, as they were very expensive then at $1700 each.

Brick oscillators are popular because they're compact and easy to use. In a microwave station, they eliminate the need for any other oscillator multiplier chain or signal source from microwave to your basic IF conversion frequencies. With a brick oscillator and its respective internal crystal, and a mixer, you have the basic setup for transceiving on either narrowband FM or SSB; on 10 GHz, or other microwave frequency.



Ed Barbacow K3ZCY (FM09AV) advertises his passion in ham radio on his license plate.

"A simple, stable local oscillator (LO) is the key to operating on your chosen (microwave) band."

Inside the Brick

Though there are many brick manufacturers, California Microwave and Frequency West (both in the San Franscisco area) are the most popular. All brick oscillators have a high power microwave oscillator in the 1.2–1.4 or 1.7–2.0 GHz range. Power output is about 1 watt. Two, three, or four transistors in parallel form the oscillator circuit for different power output levels. Sometimes companies junk these devices when one of the transistors goes open, lowering output power. Though it's unsuitable for commercial use, it's still fine for amateur use.

The high power oscillator is multiplied to the higher microwave band by a very efficient step-recovery diode (high priced varactor), producing many high order harmonics. In the case of the 1.7 GHz oscillator, the sixth harmonic is bandpass filtered (low loss), and provides high loss to the other, unwanted harmonics. This filter has an easy job, as the harmonics are widely spaced (1.7 GHz). Power output from the filter is about +10 to +20 dBm with +10 dBm being normal on the surplus (bad) units I've obtained.

The neat trick of these oscillators is that they maintain frequency at 10 GHz to about 200 Hz for short term (several day) stability. Frequency drift over a week of operation would yield errors at 10 GHz of 5 to 10 kHz. With better temperature stability applied to the 100 MHz crystal, errors have been reduced to 2.4 kHz per week. The surplus cost of the brick, modest compared to a crystal oscillator and its multiplier string, makes the brick more than worth it. Thus, this makes them ideal for narrowband operations, or operations that require high stability, such as packet and other data transmissions and SSB.

How the Brick Works

It's quite simple. The brick operates from a −19 volts. An internal crystal reference oscillator operates in the 96 to 108 MHz range, depending on microwave output frequency. The crystal oscillator is buffered and amplified in a power amplifier to about ½ watt.

The power amplifier stage drives a varactor to produce a signal rich in harmonics to the signal mixer. The high power microwave oscillator is also injected into another port of the signal mixer. The sum/difference product from the signal mixer is applied to a video amplifier whose output controls a varactor in the high power microwave oscillator cavity. See Figure 1 for a block diagram of the brick oscillator.

The sum/difference product applied to the video amplifier changes its DC output higher or lower, biasing the varactor to try to lock up the microwave oscillator to a harmonic of the crystal reference. The circuitry of the brick oscillator is such that, if lock is lost, there is a sweep circuit that will cause the microwave oscillator to vary in frequency (slow fixed-rate sweep) in an attempt to regain lock.

However, if the circuit is so far out of lock, you have to restore (lock) range with a mechanical

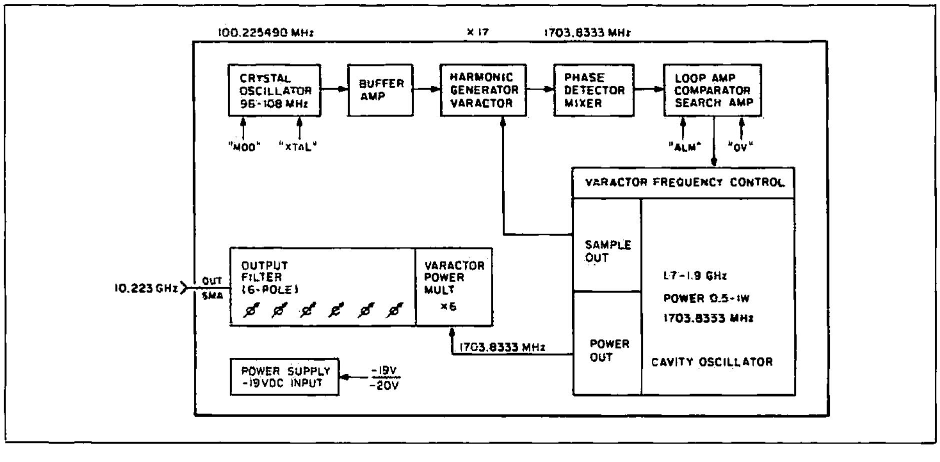


Figure 1. Block diagram for your basic microwave brick oscillator.

adjustment. Normally, the microwave oscillator will lock over a 10 to 20 MHz range. All this house cleaning is taken care of with internal circuitry, as the brick is completely self-contained. Lock indication is verified by the "ØV" or phase terminal on the brick. When not in lock, the brick will be fixed at −9.5 volts.

When the brick is in lock, adjust the microwave cavity while watching the "ØV" or phase terminal with a voltmeter; it will vary from about −2 to about −13 volts. The brick is mechanically set to −7.5 volts, the center of its lock-in range.

You can verify that the crystal oscillator is functioning properly by metering the crystal terminal. You'll read about 1–2 volts, depending on crystal activity and circuit adjustment. Built for the telephone companies where power is positive ground, these units require a −19 volts at 500 mA, with slightly higher current until the crystal oven throttles back. Some of the oscillators are marked for −20 volts, and the difference is that these units have an internal rectifier diode protecting the oscillator from accidental reverse polarity. It also drops the input voltage 0.7 volts, making both oscillators otherwise identical.

Crystals for the bricks are specially ordered for each type, as they are cut to a very close tolerance. For a Frequency West brick, type MS-54XOL (10 GHz) is needed for 10.223 GHz. Specify part #585132 from International Crystal. If your brick is different, and you're unable to locate the exact type of crystal, give them all the information on your oscillator type. Cost per crystal runs about $15.

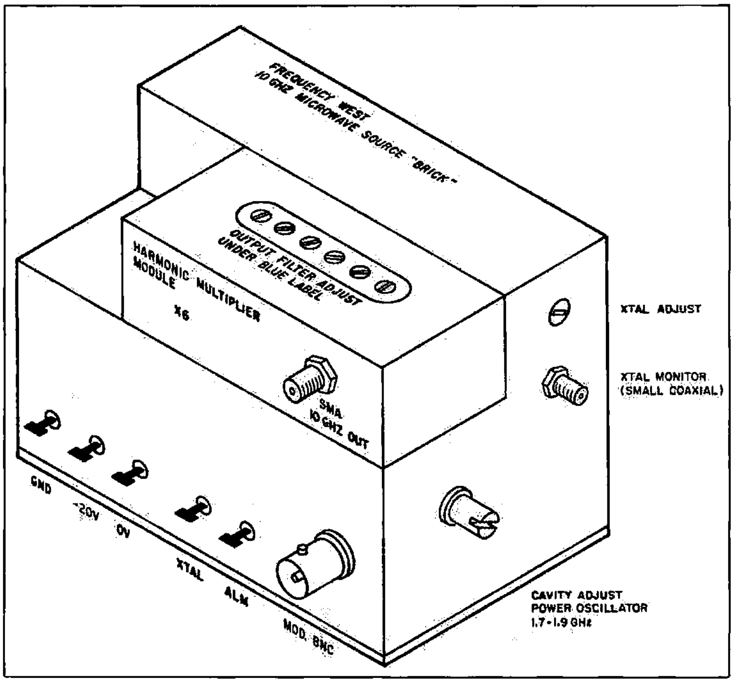


Figure 2. Frequency West 10 GHz microwave source "brick."

Modifications for the Brick

With simple modifications, you can outfit brick oscillators with connectors on the high power oscillator, tapping part of the power for uses still locked in the 1.2 or 1.7 GHz range, depending on which type of brick you have. Also, you can use this connector for injection to a different varactor multiplier filter for other frequency combinations.

These bricks don't operate on our bands, so you need to adjust them. First, adjust the output filter to pass the next lower frequency harmonic. This retunes them from 11 GHz to the lower 10 GHz range. In my Frequency West brick model MS-740MXQL-37, a crystal at 100.225490 MHz is mixed (the seventeenth harmonic) with the microwave oscillator (locked) at 1703.8333 MHz. The 1703.8333 MHz oscillator (high power) is multiplied (times six) to our 10 GHz frequency, or 10.223 GHz. This is mixed with a 2 meter IF 145 MHz, and then you have 10.368 FM or SSB, depending on the IF unit capability.

The most common surplus bricks I've obtained are in the 10, 6, 3, and 2 GHz ranges. The oscillator scheme is similar in all other models. Once you obtain an oscillator and mixer combination for any of our microwave bands, you're almost ready to place a microwatt transceiver in operation. With such a setup (no preamp), power output is just less than 1 milliwatt. This has worked paths over 100 miles. How about that for QRP? Couple this with relay switching and preamps, and you have an excellent station operating SSB or 5 kHz deviation FM.

"All the (microwave) oscillators I've obtained over the years have been surplus items costing $20–50 each, depending on condition."

Mailbox

That's it on the brick this month; I'll soon cover mixers and their use. Now, for the Mailbox. Curt Law WA2PIV/KL7 reports installation of a new 10 GHz beacon operating from Kodiak Island on the northern edge of the Heitman Ridge. The beacon operates on 10.260 GHz, 10 mW, 75 feet up a tower. The antenna is a 17 dB horn pointed towards Washington State. The beacon will be on the air until the access road to the microwave site freezes. Contact Curt for info at PO Box 1538, USCG, Kodiak AK 99619.

Ed K3ZCY reports having an 11 GHz surplus transceiver and wants to know how to turn it into a 10 GHz transceiver. The unit uses WR-75 (WG-17), the next size smaller guide than the normal WR-90 (WG-16). Not to fret. Ed's solid state Raytheon radio is quite usable at 10 GHz, especially the brick oscillators and the TWT (traveling-wave tube) amplifier (20 watt output), mixers, and waveguide components. The radio's baseband IF system can be bypassed and replaced by a 2 meter HT.

In the above case, if SSB or narrowband FM is desired, the rest of the equipment isn't used. But if TV were used, the entire IF system might be used at 70 MHz. Concerning the antenna feed, it's best to stay with waveguide due to its very low loss. 30 feet of waveguide WR-75 would have about 1.3 dB loss, far better than any coaxial cable. See Ed's license plate in the photo.

Stephen N8JAF in the Dayton area would like to establish a 10 GHz link about three miles away. He'd like to hear from any other microwavers in the Dayton area. Jay N1GBS is collecting components for his microwave station, while Bruce N8IRW is looking for a manual or schematic to an Alfred 654C 7-11 GHz sweep oscillator. He would appreciate any assistance. Andy N6HDS reports that all the BMWs and Porsches react when he goes 10 GHz mobile! Looks like the radar detectors are working just fine.

James Fisher from Sacramento writes, "I am a 'soon to be Novice' radio Ham." He expects to take his exam in a few weeks. He is very interested in microwave communications and is looking forward to experimenting with home-brew microwave equipment. He is especially interested in various technical publications concerning microwave related items. I notified him about the North Texas Microwave Group newsletter. If you're interested in this bi-monthly publication, contact Wes Atchison WA5TKU, Rt. 4, Sanger, Texas 76266. Dues are $12 a year.

Wish I could comment on all the letters I've received, but space dictates only a few. Thanks for your support. As always, I'll be glad to answer any questions. Please send an SASE for prompt reply. 73s, Chuck WB6IGP.

CIRCUITS

Great Ideas From Our Readers

Copy Better RTTY on the KAM

I came up with this circuit because I was getting a lot of hits on traffic nets using RATT (RAdio TeleType), known as RTTY in the ham circles. I use the Kantronics all-mode (KAM) TNC and the Kenwood TS-440S, which has a good AGC system. It responds however, to only the strongest of the two tones in a RTTY signal. Unfortunately, I've found no way to disable the AGC action in the 440S. Changing the time constant or biasing the radio up a bit with the RF gain control can help reduce the problem, but not defeat it entirely.

Since the problem is selective fade on only one tone at a time, that tone falls below the TTY detector threshold of the KAM and the character fails to print. Curing the problem with an amp may first come to mind, but the input specs of the KAM prevent you from giving it more than a 1 p-p signal. By slightly amplifying the weak tone signal with a single-stage op amp (without letting the strong tone over-drive the detector in the KAM unit), you can achieve improved circuit operation and better printing.

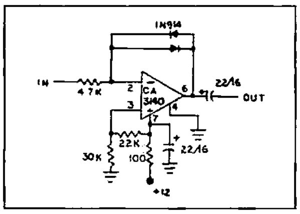


Figure 1.

As long as the output of the op amp is below the barrier potential of the diodes (1N914), the amplifier stage has a gain of 10,000. As pin 6 (output) goes above this level, the feedback through the diodes reduces the gain to less than unity. Consequently, everything, including noise, is amplified and clipped to about 1 volt p-p. This happens on a cycle-to-cycle basis. The limit is soft to the extent that the edges of the output are rounded, minimizing harmonic distortion. Now hits occur only when one of the tones goes completely away; that will simply kill a letter, rather than a whole word.

At first, I used a dual ±12 volt DC supply, but later decided to use the station signal +12 volt DC supply. I used a readily available GE/RCA CA3140 op amp, which is a good op amp with FET input and operates well on a single voltage power supply. The circuit worked better with pin 3 biased to pin 7 rather than to 6 volts DC. Using a 1 µF coupling capacitor, I obtained a differentiated wave shape output, but a 22µF output coupling capacitor solved this problem.

NOTE: This circuit does not work on HF packet. The amplified noise keeps the TNC in the KAM from sensing an open channel, preventing transmission.

Phillip W. Elrod
K4COF/AFA2KQ
Doraville GA

Drive the MM 432/28 with the IC-745

Here's a way to use the 745, or any HF rig that has a minimum output of 10 watts, to drive the Microwave Modules 432/28 transverter. I turned the output all the way down and used a 16 dB attenuator in the output. The accompanying circuit is the attenuator. Refer to the *VHF/UHF Manual* from G. R. Jessop G6JP, published by the Radio Society of Great Britain, for an extensive discussion of this.

Parts: R1, R2 = 68Ω, 1W; R3, R4 = 39Ω, 1W; and R5, R6 = 68Ω, 1/2 W.

Bob Bartelings VE6CBN
Alberta Canada

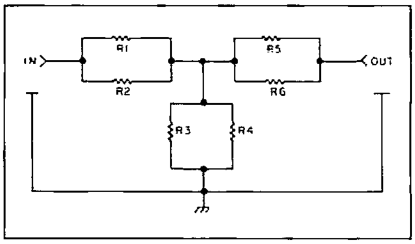


Figure 2.

3-Position, Multi-Mode Switch Box

It's not uncommon to find stations outfitted with RTTY, packet, FAX, and SSTV equipment. A 3-position switch adds convenience and saves time—no more disconnecting and reconnecting.

This control box was designed for the Kenwood TS-830S. It'll also work with the 520, 820, and 530S, and rigs which use a standard 4-pin microphone jack. The circuit consists of a 3-pole, 3-throw (3P3T) nonshorting rotary switch.

Mount the switch on the chassis. I put the cabling and 3-input jacks on the back panel and rotary switch on the front. Follow the pin layout carefully; be sure you don't cross-wire any connections, since you're working from the back of the chassis-mount microphone jacks.

Before using the control box, recheck your work with an ohmmeter. Shorts or cross-wiring could damage your transceiver or any interfacing equipment.

Parts: 3 4-pin chassis mount socket, RS 274-002, $1.29 each; 1 4-pin mike plug, RS 274-001, $1.69 each; 1 metal cabinet, RS 271-251A, $2.99; and 1 3P3T rotary nonshorting switch. Other items include solder, hook-up wire, and single conductor wire with braided shield. For the finishing touch, try DATAK™ transfer lettering and a light coat of clear spray enamel.

No more multi-mode patch cord blues!

David K. Pelaez
4872 Trailside Ct.
Huber Heights OH 45424

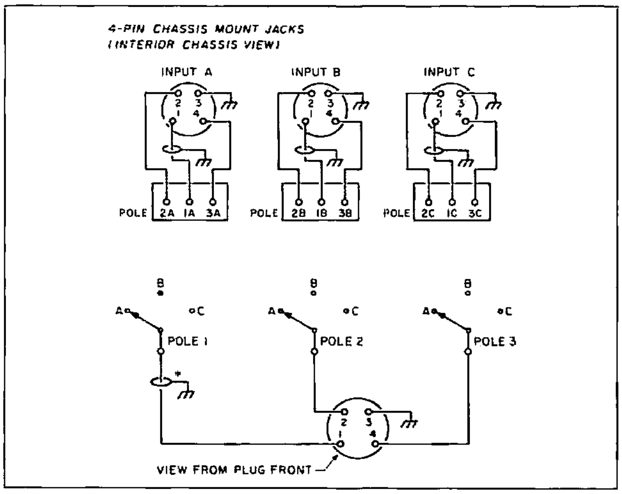


Figure 3.

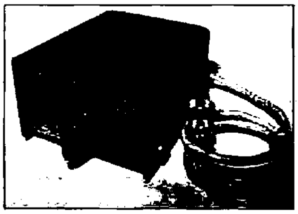


Photo A. Multi-mode controller, front view.

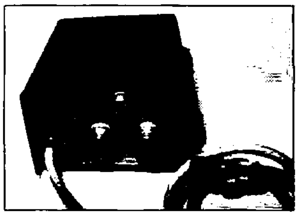


Photo B. Multi-mode controller, back view.

Number 24 on your Feedback card

ASK KABOOM

The Tech Answer Man

Michael Geier KB1UM
7 Simpson Court
S. Burlington VT 05403

Walkies and Chips—It's a Mod, Mod World

While researching another article, I recently spoke with Chip Margelli K7JA of Yaesu USA. I mentioned the FT-411's lack of receiver sensitivity on the public service bands, and he described a modification to improve the performance. I tried it and it works, (although not as dramatically as I'd hoped). If your rig is out of warranty and you'd like to do the mod, the section below tells how:

First of all, please don't do this unless you feel competent to do so! This radio incorporates the most up-to-date miniaturization techniques, including extensive use of surface mount technology, and I do not want to be instrumental in anyone's damaging his rig. If you're not sure you're up to it, enlist a friend who is.

FT-411 Modification

Remove the battery pack and the two silver screws on the bottom nearest the front of the radio. Now, remove the two black screws on the back. One is just below the PTT switch and the other is just below the hook for the carrying strap. Now, carefully lift the front panel up from the battery end, then pull gently downward. It'll pop open at the top.

Gently turn it over to the right. It is held by a ribbon cable, and you must not pull hard on it, or it could break. Look down at the circuit board contained in the back half of the radio. There are three small IF cans mounted in a vertical row on the motherboard. Using a small adjustment tool, turn the top two of them fully clockwise, then back them out just a tad. When turning them in, be extremely careful that you don't force them past their natural stopping points, or you may damage the cores or the coils themselves.

That's all there is to it! Close the rig up by fitting the front panel in at the top and then pressing the two halves together. (Don't forget to replace the strap hook first!) Finally, replace the screws.

Chip claims there is little or no effect on ham band reception, and that reception of the public service band frequencies will be significantly enhanced. This seems to be the case with my rig. (In fact, new '411s are being aligned this way at the factory.)

Alignment Tool

By the way, if you don't have a proper plastic alignment tool, you can make a temporary one from a Q-Tip, as long as it's the kind with a wound paper stem. The blue plastic kind doesn't work.

Just cut one end off, then shape the stem end by cutting it with a pair of dikes. It should last long enough to get the job done. One thing I definitely don't recommend is using a screwdriver to adjust coils. The cores are brittle and they can crack very easily if they stick while you're turning them with a screwdriver. A cracked core is a disaster!

Thanks for the Memories

I got a very nice letter from Bob K9JMP, in which he relates an idea suggested by Claude WA9KCU. You can use any walkie that can store independent receive and transmit frequencies in memory to hold extra frequencies, as long as they're just for receiving. Simply program them in as the split transmit frequencies, and then use the "reverse" function to get at them. Voila—two frequencies in one memory.

Of course, they won't scan, but at least they'll be there. Seems to me the technique should be especially useful when you're traveling and run out of memories in which to place local repeaters. Stash some of your home or public service band frequencies as Claude suggests, and you're ready to go! It's one of those ideas that makes you wonder, "Why didn't I think of that?"

Too Much QRM, OM

Sounds like something you'd hear on 20 meter DX, right? Well, now we have auto-QRM on 2 meter packet as well. No, not QRM from cars. I'm referring to hash from the TNC getting into the rig and making reception difficult or even impossible. It appears to be worst on 145.01 (good old Murphy), and especially seems to be a problem when TNCs are used with walkies.

Unlike mobile rigs, many HTs have partial or even total plastic cases, and the hash can get right into the receiver without benefit of antenna. Toroids on connecting cables, and even remote antennas, may not help. The TNC's clock oscillator generates a harmonic which just happens to fall on 145.01, causing this problem.

The solution is to open up the TNC and look for a trimmer capacitor associated with the clock crystal. Turn it slightly while listening to the receiver, and you should be able to shift the harmonic away from the packet frequencies. TNC operation should not be affected in any way, as the oscillator's frequency change will be very slight.

If your TNC has no trimmer, check the schematic and you should find a fixed capacitor of maybe 47 pF or so, either across or in series with the crystal. Try adding another cap, perhaps 4.7 pF, in parallel with it and that should do it.

Pass the Chips

We all know that our gear is filled with integrated circuits, or chips. Most of us know what they look like. Surprisingly, though, lots of hams have little or no idea what is inside those little black boxes with all the legs. So, let's explore them.

You've heard that chips can contain lots of transistors. How the heck do you fit all those things into something so small? What's more, how do you connect them? Are there little tiny wires or what? Well, sort of, but not quite. There are lots of parts and conductive paths between them, but they're not separate. Instead, they're integrated on a common surface, called a substrate. Hence the name "integrated circuit."

Transistors are made by implanting certain chemicals into a semiconductor surface, usually silicon, in layers. The meeting points of the layers constitute the junctions where the transistor effect occurs. So, why not build these layers on a large area and make many transistors at once? Obviously, simply using a large area would result in one big transistor! Some sort of isolation from area to area is needed to establish a circuit path.

Photography provides the means. If you've ever developed your own film, or made a printed circuit board, you're familiar with the concept of etching. A light-sensitive solution is placed on the material to be etched (for a PC board, that's copper), and then the pattern to be etched is focused on the surface by means of a mask. The areas which receive light chemically harden, while the dark areas do not. A dip in an acid bath leaves only the hardened areas, and the board is ready to be drilled and stuffed with parts.

Essentially the same thing is done with chips, except on a microscopic scale. Starting with silicon, not only the conductive paths, but the parts themselves, are etched onto the chip layer by layer. Chips are really three-dimensional, often with several layers of aluminum conducting paths as well as various multilayer transistors, resistors, and even capacitors. Many chips can be made side by side on the same "wafer," or piece of silicon.

Inside the IC

Getting all this to actually work requires some of the most expensive and sophisticated manufacturing equipment on Earth. The alignment of the masks from layer to layer must be extremely precise, or the circuit elements won't line up. Machines called "wafer steppers" do the job, and each one costs about one million dollars!

At that size scale, the tiniest piece of dust is like a giant boulder, and can obscure a piece of the circuit during the exposure process, rendering the finished chip defective. Elaborate "clean rooms" are used—the cleanest rooms in existence, making the average hospital operating room look positively filthy. All told, millions of dollars' worth of equipment are required to produce even a single chip. ICs are cheap only because so many can be made at once, splitting the cost among millions of chips. If there were only 10 microprocessors in the world, each one would probably be worth about $50 million.

The fundamental limitation on how many parts can be put on a chip is, of course, how small each part can be made. Currently, that is limited by the wavelength of the light used to expose the wafer. Surface features less than one micron (one one-millionth of a meter) in size are now being explored using electron or ion beams instead of light.

Whew! There's lots more to chip making, from the precise "cooking" of the chemicals into the silicon, to the packaging and connecting of leads. But this should give you a good feel for what's inside those leggy little

beasts comprising so much of your radio's innards.

Now let's look at some letters:

Dear Kaboom,

When my son was in Japan, he bought me a Kenwood TH-21. Period. No "A," "AT," etc. The rig has no offset switch at all. Please describe how I can install the plus/minus feature.

Signed,
The Simplex Blues

Dear Simplex,

Wow, that's a tough one! The regular TH-21AT uses separate crystals in one of the heterodyne oscillators, along with some TX/RX switching, to achieve the offsets. Since yours has no offset switch, I would expect that it also doesn't have the supporting offset circuitry. Especially considering the '21's miniaturization level, which includes extensive surface-mounting of parts, it's likely not worth trying.

You'd be better off using the rig for packet (which is a simplex operation) or selling it to someone for that purpose, and getting another HT. But before you do, check to see that the radio is actually designed for simplex use, and does not simply have a fixed offset.

Dear Kaboom,

My old Yaesu Memorizer mobile rig picks up quite a bit of alternator whine, especially in transmit. I can live with it, but I want to know, can it hurt the rig to use it this way.

Signed,
Whine, Whine, Whine

Dear Whine,

It sure can. Alternator whine is caused by spikes on the DC power line. The spikes are caused by the rectified current pulses from the alternator being fed to the car battery. They can be quite large and can damage transistors and ICs in your rig. The cure is fairly simple.

Go to Radio Shack or an auto parts place, and get a noise filter choke. Put it in series with the positive power input to your rig. If there is still some whine, try placing a large filter cap (a few thousand microfarads or more), rated for at least 50 volts, across the radio's power leads, AFTER the choke. Be sure to observe correct polarity when installing the cap, and do it with the positive lead disconnected from the car. That ought to clear it up. ■

Number 25 on your Feedback card

NEW PRODUCTS

Compiled by Linda Reneau KA1UKM

PRODUCT OF THE MONTH

ICOM AMERICA, INC.

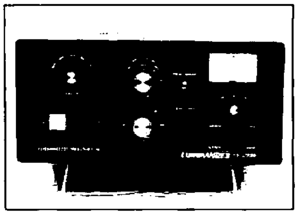
THE ICOM IC-24AT

Icom's new IC-24AT is super compact at 2"W x 5.4"H x 1.4"D and 12 ounces. The multi-functional, dual-band transceiver delivers a 5W output at 13.8 volts DC. Audio output power is more than 200 mW at 10% distortion with an 8Ω load. It can turn itself on at a preprogrammed time and turn itself off when unused. A battery pack from BP-81 through BP-86, or external DC power jack 6–12V DC, supplies power. Select tuning step increments of 5, 10, 12.5, 15, 20, 25, 50, to 100 kHz, or 1 MHz. Other features include dual-band display, scan and monitor functions, and optional tone squelch function.

The IC-24AT can simultaneously transmit on 144 MHz and receive on 440, or vice versa. The keyboard, complimented by the top panel tuning control, makes it easy to program the 80 memory channels and use the two call channels. You can store frequently used phone numbers in the four DTMF code memory channels for automatic dialing.

Suggested retail, $629.00. *Icom America, Inc., 2380 116th Ave., NE, PO Box C-90029, Bellevue WA 98009-9029. Tel. (206) 454-8155. Customer Service (206) 454-7619. TEL: 152210/ FAX: (206) 454-1509.* Or circle Reader Service No. 201.

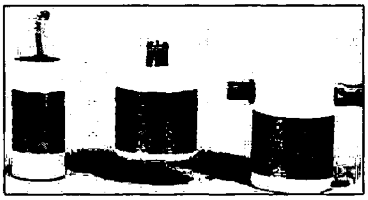
COMMAND TECHNOLOGIES, INC.



The Commander HF-2500 high frequency amplifier delivers 1500 watts of continuous carrier output using a pair of Eimac 3CX800A7 triodes requiring 50–80 watts of drive. It operates on 160, 80, 40, 20, and 15 meters, and the WARC bands. With an easy modification, it can perform on 10 meters. Maximum plate dissipation is 1600 watts. It can handle high duty cycle emissions, such as RTTY, SSTV, FM and AM, as well as SSB rag-chewing and CW.

Other features include negative going ALC with easy rear panel adjustment for tuning, harmonic suppression, intermodulation distortion better than 35 dB below rated output, and full-cabinet pressurized forced-air chassis for cooling.

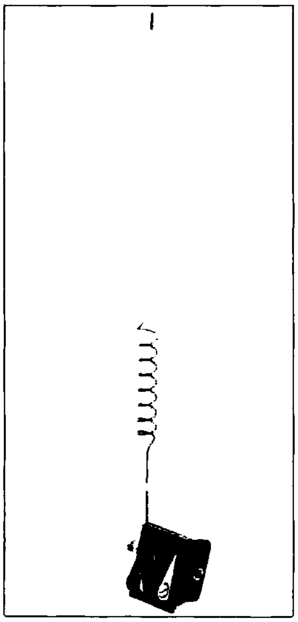
The 70-pound, 17"x16"x7¾" Commander HF-2500 is $2188. *Command Technologies, Inc., 1117 West High Street, PO Box 939, Bryan OH 43506. (419) 636-0443 or Customer Service (800) 736-0443.* Or circle Reader Service No. 202.



TCE LABORATORIES

TCE Labs of San Antonio announces almost 100% of the users of their Model BX TVI filter report no trace of interference. Tom W4PSC, retired research engineer and ham for 52 years, says he designed this filter out of necessity; he had tried every filter available on the market, and his TVI remained unchanged.

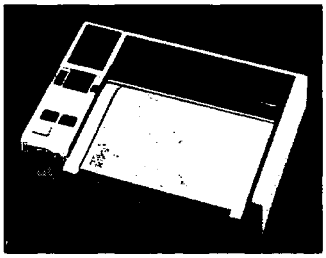
The Model BX TVI filter attaches to the F-connector cable TV input or coax cable VCR input. TCE Labs sells the BX filter for $23, and Model CX tor the neighbor's TV or VCR for $18 (shipping included; Texas residents add 8% sales tax). TCE also sells an effective telephone filter for $16 (add $2 S&H, if ordered separately). Send check or MO to *TCE LABS, 5818 Sun Ridge, San Antonio TX 78247.* Or call *(512) 656-3635 for more information or (800) 545-5884 (1800 KILL TVI) for immediate delivery.* Or circle Reader Service No. 203.



THE ANTENNA SPECIALISTS CO.

The Antenna Specialists Co.'s new Model AP-143 "On-Glass"™ disguise antenna covers the 2 meter band. It borrows the "pigtail" configuration of cellular antennas to disguise the presence of professional radio equipment inside the vehicle.

The capacitively coupled transmission through glass requires no ground plane and permits quick, no-holes installation. VSWR is less than 1.5:1. Power rating is 100W continuous and 150W intermittent. The 26" stainless steel whip is covered with a black DURA-COAT™ finish. Suggested retail, $65. *The Antenna Specialists Co., 30500 Bruce Industrial Parkway, Cleveland OH 44139-3996. Tel. (216) 349-8400. TLX 4332133.* Or circle Reader Service No. 205.



ACE COMMUNICATIONS, INC.

The WX-1000 produces hard copy images from radio facsimile services, including NOAA weather chart, NFAX, press photo, and satellite weather pictures from NOAA, GOES, and METEOR, etc. It requires audio output from a shortwave or S-band receiver capable of receiving facsimile signals. The built-in high resolution, 24-pin thermal printer produces crisp images. It's also capable of producing gray scale, ideal for APT (Automatic Picture Transmission) by weather satellite.

Power requirement for this 5.37 kilogram (with paper roll) printer is 120V AC or 13.8V DC. *ACE Communications, Inc., 22511 Aspan Street, El Toro CA 92630-6321. (714) 581-4900 or (800) 523-6366. FAX (714) 768-4410.* Or circle Reader Service No. 204.

HEIL SOUND

The Heil BM-5 single-element boomset is one side of the Heil BM-10 dual-headphone boomset. This new BM-5 is great for mobile use in states where dual-element earphones are illegal. The microphone boom is available with either of the Heil "Key Element" cartridges—the HC-5 for full-range response, or the HC-4 "DX Dream Machine."

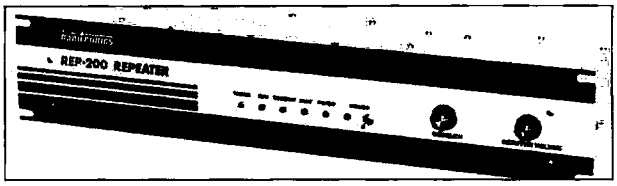
Price, $65. Contact *Heil Sound, Ltd., Heil Industrial Blvd., Marissa IL 62257. Tel. (618) 295-3000.* Or circle Reader Service No. 208.

ENGINEERING CONSULTING

Engineering Consulting now has the "Packet Talker," model PKTA, for the Commodore 64 and compatibles. "Packet Talker" converts ASCII messages into speech. You can store messages for up to 300 users and retrieve them with TouchTone commands, and use the "Packet Talker" to link your TNC with any voice repeater.

A similar option for the PK8 and PK1 TNCs is available for the Ultra Com Shack 64 repeater controllers. Used with the Ultra, the "Packet Talker" is much more powerful, allowing complete control of the repeater, remote screen transfer of all active parameters, voice message, and remote programming.

Model PKTA provides hardware and software interfacing for the C64. It sells for $190. *Engineering Consulting, 583 Candlewood St., Brea CA 92621. Tel. (714) 671-2009. FAX (714) 255-9984.* Or circle Reader Service No. 206.



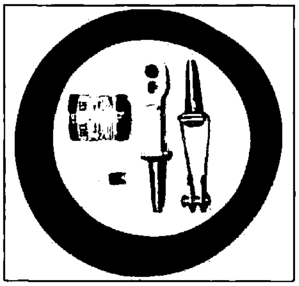
HAMTRONICS, INC.

Hamtronics' new REP-200 repeater has everything their existing repeaters have, plus a microprocessor-controlled COR, CWID, autopatch, and DTMF decoder/controller with over 45 functions, including built-in testing features. It's available for 10m, 6m, 2m, 220 MHz, 440 MHz, 902 MHz, and for HF and UHF commercial bands.

Four PCBs have been combined into one module, with IC sockets for easy service. Surface mount capacitors reduce size and enhance performance. Interconnections through the controller board eliminate cable harnesses. External cables are made with push-on terminals which plug directly into the controller board. Added front panel indicators and color-coded LEDs indicate status of major functions. Welded RF partitions are part of the new compact chassis, with Pem nuts sealing the covers for shielding.

For 2m and adjacent commercial band, a new 25W RF output option is available. If you need even more power, you can add the 100W PA. On UHF, choose from 10W with basic repeater or up to 65W with add-on PAs. On 900 MHz, choose 10W basic repeater or 40W with add-on PA.

The REP-200 is $1295. *Hamtronics, Inc., 65-F Moul Rd., Hilton NY 14468-9535. Tel. (716) 392-9430/FAX 9420.* Or circle Reader Service Number 209.



PHILLYSTRAN®

Phillystran's nonmetallic, maintenance-free tower guys eliminate distortion caused by re-radiated signals. No insulators are required for these electrically transparent guys, and they are immune to corrosion, stretching, arcing, zapping, snapping, and aging problems.

Phillystran tower guys are protected by an extruded olefin copolymer jacket. To prevent damage by fire or vandals, Phillystran recommends that you use short lengths of steel cable in the lower portion of each guy.

For more details on Phillystran® HPTG rope, tower preparation, and SOCKETFAST® BLUE, the resin potting compound used to terminate HPTG rope, contact *Phillystran, United Ropeworks (USA), Inc., 151 Commerce Drive, Montgomeryville PA 18936. Tel. (215) 368-6611. TLX: 846342. FAX (215) 362-7956.* Or circle Reader Service No. 207.

LETTERS

From the Hamshack

Appeal for Young Hams

I've heard about your call for youth in ham radio. I am an eighteen-year-old General class licensee, and am very concerned about the future of ham radio. Ham radio has been around since before World War I, and is still strong, but the old guard slowly dwindles and there are not enough young adults to carry on the ham radio tradition.

It's everyone's responsibility to get young people involved before it's too late. We need to show them there's more to life than parties or who's wearing what. We need to open their eyes to the wonderful world of ham radio. How?

Show them how special they are. Show them that they can get on a radio and talk to anyone in the world. Get them involved in public service, such as in events that demand communications, like parades, 10k races, etc. Yes, it will not be easy at first, but now is the time to really start searching for them, especially with no-code in progress. If we could get them to put as much energy into ham radio as they do with parties and fashion, then the hobby will be carried from generation to generation. The young folks are who we really need to shoot for, and the way to be successful is to show them how valuable they really are in this world of ours.

Kelly Howard N6PNY
Saugus CA

Closer Look at ROSE

I would like to address some of the comments made about ROSE in the article "Amateur Packet Networking" in the October '89 Packet Issue. It is stated that, "The . . . protocol used . . . is called AX.25 because it is based on the worldwide computer networking protocol X.25." AX.25 actually is only a small portion of X.25. The original authors of the AX.25 protocol wanted to include the full features of X.25 because in many countries X.25 MUST be used for networking.

"The major advantage of ROSE is that it is available from RATS at little or no cost." We should not evaluate networking solutions using cost as a major consideration. Technical merits of a solution might be more important.

It is stated that the major problem with VC-based networks is that "a disconnect anywhere along the line breaks the entire link to the destination." One factor overlooked is that the VC method reduces BBS message duplication greatly. This is one of the real advantages of ROSE.

"ROSE can't communicate with NET/ROM, NET/ROM can't . . . TexNet, and TexNet can't . . . ROSE, etc." This is true only on the network level. On the AX.25 level, they communicate quite well. In New Jersey, we forward at least 1000 messages each month between ROSE and NET/ROM networks on the AX.25 level.

I personally feel that networks based upon "the worldwide computer networking protocol" should be given serious consideration if we are to ever create a global amateur packet network.

Thomas A. Moulton W2VY
Clifton NJ

See the Packet Talk column by Brian Lloyd WB6RQN in this issue for clarification of misleading statements in the October '89 packet issue . . .

Linda KA1UKM

Make it Fun

Until your editorial about high school ham clubs, I didn't know we started a high school ham club in tough times in 1972. Four of us were already hams and we convinced my physics teacher to be our faculty advisor. We showed how learning the code and theory was fun. We provided communications for school competitions. The last time I checked the Callbook, our club callsign, WB4DDF, was still listed. Emphasize ham radio as fun, and you will get positive results.

Steven Putman N8ZR
Fairborn OH

Never Say Die

continued from p. 4

WA3YQY, Carlos Opus I, the Scourge of Eddyville (NY), has cleaned his area of jammers, breaker-breakers, tail-enders, and long-winded wimp old-timers with nothing whatever of interest to talk about.

living in caves, came up with a wonderful no-code license several years ago. It's incredibly like the ARRL proposal. It also has attracted less than 100 takers so far. Talk about a bomb. We couldn't pick a worse model to emulate if we had even the slightest interest in actually solving our problem. No, this debacle had to be planned—it's too dumb to be an accident.

Three Steps to Winning

Yes, I believe amateur radio can be saved. I believe it's possible for us to (1) clean up our bands so any thinking newcomer will not compare us unfavorably with CB; (2) actually have many interesting conversations over the air, not only locally, but even internationally; (3) attract youngsters to our hobby on the basis that it's fun.

It doesn't take much listening to discover that we have some serious people problems in our bands. Hams like K1MAN need to have the concept of others' rights explained to them. KV4FZ needs to understand the ramifications of his actions and how severely he is damaging our hobby. I singled those two out because I have a stack of recent complaints about them. There are hundreds of hams who are lousing up our nets, repeaters, traffic handling and so on. Many of these are not going to be easily convinced to stop messing up our bands. Many are going to be major challenges to our ingenuity since they seem to be all mouth and no ears.

We need some sort of Band Police system. Unfortunately, all too often the police become as much a part of the problem as the solution. We have only to watch the police in Chile beating people to death—the army/police in Israel shooting children—the army/police in China shooting thousands of children—the death squads in Central and South America "disappearing" thousands of troublesome people—to see where police action can go wrong.

What about our "police," the FCC? Every few days I get copies of complaints filed with the FCC citing well-documented intentional ham interference cases. Some groups, frustrated by the FCC disinterest, have started peppering their congressmen with complaints. Unfortunately, these complaints are far more destructive to the future of amateur radio than the perverse actions which are causing them. Bureaucrats tend to shoot the whistleblowers—kill the messenger.

Well, if I'm not suggesting our forming vigilante parties to string 'em up, nor our turning to what we perceive as our authorities for help, where can we turn? We do have an almost completely unused strength—a powerful strength. If we use this strength, I believe we can clean up our bands in a surprisingly short time. This strength lies in our thousands of ham clubs. It lies in our working cooperatively to clean up the mess. Remember, we outnumber the bad guys a hundred to one—if we cooperate.

By organizing our defense against the garbage on our bands—against the ham terrorists who are ruining amateur radio for the rest of us—we can, if we work smart, get them to cooperate.

This starts at home. At the next club meeting, form a garbage cleanup committee whose purpose is to tackle local repeater problems. The committee will be looking for jammers, offensive language and other inconsiderate activities. Getting the hams who are making the mess to clean up their act requires both tact and firmness. If you come on as officious and unreasonable, you'll stir up a worse hornets' nest.

When I'm in the middle of a QSO on a repeater, breaking back and forth, I get as irritated as anyone else when someone comes on and lectures me about the FCC regulations on identifying. If he broke in and asked for my call, I'd have no problem. Few people are comfortable with being told what to do, but most of us will go that extra mile if we're asked.

If someone uses bad language, why not break in and ask him to please be careful, that your granddaughter or friends are listening? That may get more cooperation than your reading him the regulation against bad language, which can easily turn the frequency blue for quite some time.

Hunting jammers is real fun. It'll give your club some first rate direction finding experience. You can do fine with cars, but if you have a member with a plane you'll be able to home in on jammers in minutes. I remember a Massachusetts club which had a persistent jammer. DFers discovered it to be none other than the club president trying to force unwanted hams off "his" repeater! Hi, Bob.

By working in club groups and reporting repeat offenders at meetings, you'll have strength. If you find some local hams who can't be helped to improve their ways, it's time for stronger measures. This is where you need to be creative. For instance, you might consider a whole-club visit some evening to his house. Fifty or so hams knocking on the door might make an impression on even the most sour type of ham.

Now and then I get nasty letters about my editorials. I welcome ideas and facts, but not nastiness. When I get letters like that I feel sorry for the ham's family—they have to live with him every day. No nice person suddenly is nasty in a letter—that takes someone with mental problems. It's just the same on the air.

We do have some serious sickos in our hobby. Contrary to the popular myth, the code test has been a total failure in keeping out undesirables. I'm not yet completely convinced that it's the code which makes hams crazy, but I have noticed an otherwise unexplainable correlation between class of license and the number of loose marbles rattling around in many heads.

Once your club garbage cleanup committee has had success on your local repeaters, it's time to tackle low band crazies. First look for nearby hams who are screwing up, and apply your now well-developed group reasoning powers. If you hear more distant ops messing things up, try reason first. If that fails, see about getting help in their area. I'd love to list the clubs in *73* which have formed garbage cleanup squads so you'll be able to get help when you run into persistent spoilers. Their local clubs may have more success getting through to them.

The Idea is to be polite but firm. You want to get their cooperation, not get them so mad they'll jam your net until they die. If we manage to make the papers with our efforts, I'd prefer it be for picketing his home rather than fire-bombing his car.

Can We Finally End Pileups?

Pileups are caused by poor DX operating. We need to educate DXpedition ops and ops in rare countries on how to avoid pileups. Pileups are like a shark-feeding frenzy—they get started by a DX op and then get out of hand, with the DX-chasers losing all perspective and reason.

How can a DX op with a weak signal keep pileups from happening? It's easy. I've DXpeditioned from many rare countries and I've learned how to keep the pileups from happening. To brag just a bit (as usual), I've operated from KP1, 3D2, 3D6, 7P8, 7Ø, 5W4, 5Z4, KS6, KW6, KG6, KR6, 9M6, 9M8, 9N1, YK1, OD5, HS, YA, EP, FO8, FK8, VU, HL, VS6, 9V1, JY, OHØ, FP8, etc., so I'm not without some experience at this.

My operating system, once I hear the beginnings of a pileup, is to explain my rules and go by them rigidly. I explain that I'm going to stand by for about 30 seconds and write down just the last letter of any calls. I don't want anyone to send anything but the last letter of their call—one letter. I suggest they not all transmit immediately, but wait and space out their calls—with no more than two transmissions of their last letter.

I then break in and ask each letter I've heard to stand by while I list everyone calling. I keep this up until the frequency is silent. Then I ask each letter I've heard to give their call once and nothing more. I confirm the call, give the report and ask for my report, with absolutely no breakers. I then confirm my report, and without missing a beat, ask for the next letter's full call only. Once I've worked all the letters I've listed, I give my QSL information, explain the rules again and stand by to list more

letters. In this way I'm able to get right down to the QRP, weak DX and mobile stations with no pile-ups, no DX crush and no panicky DXers wondering how soon the band will change. I don't even need a strong signal to make it work.

When someone with poor operating manners insists on botching things up, I explain that if he keeps it up, no QSL.

We can cure all our miseries if we cooperate and persist.

Making Contacts More Interesting

Though I've written about this before, I haven't yet noticed any signs that anyone has been paying attention. Yes, it's difficult to make contact with someone you've never talked with before and try to develop interesting conversations. It's easier to mindlessly babble about your rig, antenna and weather, none of which is of any more interest to him than is his station to you.

The up side of our having very few young hams is that most of you can read. The question arises, if you *can* read, *are* you actually reading? Let's be rotten about this—when is the last time you read a book? Any kind of book? I'm having some interesting non-ham books included in the Uncle Wayne's Bookshop, just in case you want to give reading a try.

I look at it this way. If an old coot like me can publish *73*, put out a major music magazine (*CD Review*), and a handful of other smaller publications, run a record company, a mail order music company, etc., and also manage to read a big stack of magazines plus a couple books a month, why can't you? I'm not superhuman, I just spend my time carefully.

I also watch TV, see most of the better movies, get to concerts, go on skiing and diving trips, get to business conferences and hamfests, but that doesn't keep me from reading. So, when you contact me on the air—and yes, I even get on the air—I'll be delighted to talk with you about almost anything. If I know about it, fine. If I don't, I want to.

I can't remember anyone ever asking me what I've read recently. I often ask. I can't remember anyone in the last 50 years asking me first what I do.

You know, if you just started asking the chaps you talk with what restaurants in their area they recommend and why, you'd soon have the makings of a restaurant guide book.

Maybe they know some well-known people? Have you ever asked 'em? No one has ever asked me—and I've known a few. I also have some great stories I can tell about 'em. Ask me about Amelia Earhart, about aviation pioneer Frank Hawkes, Steve Jobs, King Hussein.

One way to help us get more interesting contacts is to have nets set up for discussing specific interests. Special Interest Group Nets (SIGNs). I occasionally call into the submariners net, the ex-GE employees net and the Mensa net. If there were nets devoted to cosmology, UFOs, new ham technologies, Gaia, the greenhouse problem, educational technologies, etc., I'd be on the air much more.

If you've got a good signal and are willing to sponsor a net, find a frequency and time which won't get others all upset and get it started. Let me know the time/day/frequency and I'll publish it in *73* so you'll have the whole country from which to draw.

The slow scanners should have a net frequency—not for sending pictures, but for discussing new circuits, new equipment and late developments. OSCAR ops have such a net. Every ham special interest should organize nets as meeting places. I remember running into a doctor net, airport manager net, ham flyer net, Westinghouse employees net—so where are the skier and skin diver nets?

Talk to me about books, music, places you've traveled, your other hobbies—talk to me! But please don't tell me what rig you bought or what antenna you've got up there. Please! I don't really even want to know my signal report—more than you're hearing me fine or, more probably, with some difficulty. I hate getting a 5-9 and then finding that about 2% of my transmissions have actually been heard. I also hate finding that the only reason someone has called me is because they "need New Hampshire." For what?

I have this strange concept of amateur radio—that it's best used for communications. I'm not sure what the driving force is behind someone having to work every country in the world. I could see wanting to *talk* with every country, but ten-second contacts just to get QSL cards? That's crazy!

Okay, okay, I know I just got through explaining how to make fast, stupid contacts. Well, I can't change the world in a day. And,

yes, I even encourage this sort of madness with my DX Dynasty award. You can't imagine how much I hate myself for that. Talk about being my own worst enemy! But when I saw the blundering mess DXCC has become, it just seemed to me that, no matter how dumb the premise, someone ought to do it better. So I started the DX Dynasty, which has 400 countries—all legitimate countries. That's how many the official IARU member societies accept as countries—and who knows better what is or is not a country than the IARU official amateur radio societies? This keeps me out of the country decision hassle and all those weird rationalizations which have hamstrung (sorry) the ARRL.

Thus, on the one hand I have an award available for hams who are unable to prevent themselves from being stupid—and on the other I'm saying don't ruin our hobby by going for these operating awards. You're going to have enough to answer for when you get your "silent key" award without having to find out how much you've aggravated hundreds of hams with your 10 kilowatt rock crusher when they replay "this was your life." If you'd read some books, you'd know what I'm talking about.

Step Three

Let's fantasize that we've reconditioned the jammers and made them honored members of our ham society. That's step one. Next we've managed to get a reasonable number of hams to actually talk about interesting things on the air. Step two. That still leaves step three, getting newcomers. At least by now we'll have a hobby of which we can be proud —something we can feel good about to sell. By the time we get to step three, it'll be easy to attract new hams. When we're ready we can tackle this hurdle. We're not ready yet.

Now, The Clubs

While there is no doubt in my mind that there are some really progressive ham clubs hidden around the country, the sad fact is that a high percentage are disasters. I mentioned addressing one recently where I was one of the youngest people present.

I wish I had the space in *73* to publish the endless letters I get from younger hams telling me about their terrible experiences in trying to get help from a local ham club. Maybe I can get these onto the *73* BBS so you can see some of the mail I get and perhaps develop a better understanding of our root problems.

I pointed out that the FCC should not be perceived as a strength upon which we can lean. I don't think they hate amateur radio, they just don't want to be bothered. Amateur radio has been a royal pain in the butt for them for years, with little on the up side.

Well then, we certainly can depend on the ARRL, right? Trying to discuss the ARRL evenhandedly is about as fruitful as trying to discuss agnosticism at a Baptist revival meeting, so I'll leave you with your beliefs and not upset you with facts. I will say that it is my considered opinion that any belief that the ARRL is going to be helpful in solving our problems is more fantasy than reality.

Okay, if we can't depend on the FCC or the ARRL to save us, certainly the ham industry, which is totally dependent on ham sales, will do it, right? Wrong.

The only strength we really have to work with is our ham clubs. We do have a few of these which are being intelligently guided—which are going all out to attract youngsters to our hobby—which are taking an interest in trying to rebuild our hobby. Alas, we have an awful lot of clubs, run by old men, which are doing all they can to keep kids out.

What I suggest you do is this: Take the time and interest to find out when your local ham clubs meet. Go to the meetings. See how they are running. Are the meetings interesting or are they dominated with "business" discussions which make them dreadful bores? Do they have exciting speakers?

Speakers. Let me discuss speakers. You'll be able to get some really interesting speakers if you try. But if you treat them the way I've been treated they'll quickly stop addressing ham clubs.

When you are able to attract a good speaker make sure that you do something special about it. Get notices in the newspapers and on local radio stations to attract an audience. Talk it up with announcements on local repeaters.

Have a pre-meeting dinner to get the speaker together with a few selected interesting club members. This will help the speaker know what the audience will be most interested in hearing about.

At the meeting immediately introduce the speaker and let the speaking commence. No "short" business meeting. No yearly elections. If you absolutely can't prevent yourself from these destructive activities, at least leave them for after the speaker has gone.

Give the speaker plenty of time to talk and answer questions. Then have the coffee & doughnuts, with a further informal talk session. Thank the speaker and give him or her some memento of the occasion.

A good friend of mine, a top ham speaker, won't talk to a club unless he gets $1,000 up front. It isn't that he needs the money, it's just that this is what he found it takes before a club will take him seriously enough to pay him some respect. I tried that and, sure enough, I found I got a lot more respect when I charged $1,000 than when I speak for free.

I remember being invited to address a ham club near Boston. They neglected to tell me how to find the meeting place—just check in on the repeater for directions. So I drove to the town and called in. No one on the repeater knew where the meeting was. I persisted and finally someone came on who was able to give me directions. When I got to the meeting, they were busy with Field Day preparations, so it was after 10 p.m., when everyone was tired and ready to go home, before there was time for me to talk. No, I don't speak to many clubs these days.

If you take the time to infiltrate your local clubs you'll be in a position to improve the meetings. Anyone who speaks up at club meetings is quickly made the club president. Get yourself in a position to make sure the club goes after youngsters and then gets 'em licensed. Make sure the meetings are fun for everyone. Get a garbage committee going to help clean up our bands. Club meetings are show biz, so they have to be planned.

Plan B

Let's indulge in the unlikely fantasy that my plan for you to get your local ham club to form a Garbage Committee to clean up our bands has fallen on the usual deaf ears. The "little old ladies" who are running the club don't think the club should "get involved" with anything as controversial as that.

I go out on a limb every month for you in my editorials and what do I get in return? I get timid, pukey, mewling letters saying yes, golly, I sure agree with you, but for heaven's sake, whatever you do, don't print my name or call. Spineless, wishy-washy, gutless namby-pambies. That isn't the spirit that made America great, that's the spirit that has helped us collapse into last place in the developed world in education and to lose our electronics industries to Japan.

Of course, if you don't read anything but ham magazines, and are thus a certified ignoramus, I can understand why you're terrified of expressing an opinion. I can also see why you might go into a quaking panic at the idea that the ARRL might sense some slight defection on your part. Some hams seem fearful that if even a hint that they are not absolutely delighted with every aspect of The

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock NH 03449, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

League is detected, the local SCMs and their dreaded right wing "death squads" will kidnap and torture them.

Now, while this may possibly be happening in some isolated areas where there are overly zealous SCMs, I don't see where this can honestly be a serious concern for most hams.

But, if you're too much of a milquetoast to go on the air and help bring reason and order to our ham bands using your own call—if you find youself going into a blue funk at the mere thought of standing up for what you know darned well is right—I have a solution. I have a way for you to be daring—for you to tell off (sort of) the cretins who are lousing up our bands without ever letting them know who you are. I have a way you can blame the whole thing on me. So, even if you are a lilly-livered, yellow-bellied, sasparilla-drinking coward, you'll still be able to lend a hand in cleaning up the mess on our bands you've allowed to grow into a monster. It's time to stop turning the other cheek. It's time for you to take a stand, no matter how weak.

Okay, here's a way we can work it. As you know, when you operate my station, you're permitted to use my call as long as I have "control," right? You can only sign my W2NSD call letters within the limitations of your license or mine, so if you've an Extra Class license you can only operate in the Advanced Class bands. If you're a Tech, you can only operate in the Tech bands, even using my call.

Now here's what you do. When you hear someone making a mess of things on the air, break in and say, "Please...please...give me a break!...this is W2NSD." If you say exactly that, as I've asked, then obviously *I* am in control of your station. If you say anything else, you're in control and you'll have to use your own call.

One voice in the wilderness asking some idiot who has been using bad language or jamming a net or a repeater to shape up won't get much heed, but if every *73* reader makes it his or her business to spend even ten minutes a day helping to clean up our bands, us good guys will be able to rout the baddies. A chap who misuses our bands may not pay any attention to one bleat of indignation, but if fifty voices, all claiming to be W2NSD, get after him, perhaps the message will eventually get across.

Notice that I've asked you to say "please." You're asking him to shape up, not telling him. It's much more difficult to ignore someone asking you than someone ordering you to do something. When I'm in control of your station be sure you don't jam or make more of a mess of things.

The normal reaction by the bullies who are messing up our bands is to launch into a long insulting diatribe. This is designed to make you mad and retaliate. This is what it's all about for this brain-damaged would-be CBer. I've found the best way to handle this is to immediately tune off the frequency when the hate starts and look up the band for other mental retards to discourage.

Of course, if you have a clean-up group working with you via a repeater, you can drive the bully nuts with different voices asking him to "give me a break...this is W2NSD."

Let me know how this works out for you. If we don't have success with Plan A or Plan B, we may have to go to Plan C, which involves Dick Bash—remember him? I've heard he's now selling AK-47s. Nothing changes.

If you're panicky that I might print your call in *73*, don't let that stop you from writing; just let me know and I'll keep it secret—although we are talking about starting a ham whistleblower relocation program. I expect to get some interesting stories of your

"Talk to me about books, music, places you've traveled, your other hobbies—talk to me! But please don't tell me what rig you bought or what antenna you've got up there."

Number 29 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
PO Box 1079
Payson AZ 85541

December Forecast

December days are the shortest of the year, so expect the higher frequency HF bands, 20–10m, to close at dark or late afternoon. Occasionally, on very good days, you will find them open long after dark.

Solar activity is higher than it has been in 10 years, and you can expect some sudden ionospheric disturbances brought on by solar flares and other events on Old Sol. As shown in the daily forecast calendar, on days with a P, F or G, expect Poor, Fair, or Good conditions, respectively. Allow for an error of a day or two in either direction.

Reading the Chart

When a given band is open to a place on Earth at a specific time as indicated on the chart, look a bit earlier, just for fun. On some days, these openings may not exist at all, so try a lower band. In many cases, you'll be pleasantly surprised to find the next higher band open as well. For the WARC bands, you'll find propagation sharing some of the characteristics of the next higher and next lower adjacent ham bands.

An * means to try the next higher band. (1) means an opening may be rare, but possible on "good" days (G). When 20/40m or 40/80m are indicated, both bands are likely to be open at the same time to the same location.

DXing

Grayline propagation, at dawn or dusk along the path of the terminator, may be especially good on all bands from 40 through 10. Keep an ear tuned to WWV at 18 minutes past the hour for current propagation conditions.

Good DX! 73

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	—	—	—	—	20	20	15	15	—	—	15
ARGENTINA	15	15	15	20/40	20/40	—	—	—	—	—	10	10
AUSTRALIA	15	15	—	—	20	20/40	20	20	—	—	—	—
CANAL ZONE	15	20	20/40	20/40	20/40	20	20	20	15	15	10	10
ENGLAND	40	40	40/80	40/80	40/80	—	—	10	10	15	20	40
HAWAII	15	15	20	—	40	—	—	—	—	—	—	15
INDIA	15	20	—	—	20	—	—	—	—	—	—	—
JAPAN	15	—	—	—	—	20	20	15	15	—	—	15
MEXICO	15	20	20/40	20/40	20/40	20	20	20	15	15	10	10
PHILIPPINES	20*	—	—	—	—	—	15	—	—	15(1)	15(1)	—
PUERTO RICO	15	20	20/40	20/40	20/40	20	20	20	15	15	10	10
SOUTH AFRICA	—	40	—	20	20	—	—	15	15	15	—	—
U.S.S.R.	—	—	—	—	—	—	20	15	20	20	—	—
WEST COAST	15	20	40/80	40/80	40/80	40/80	80	20	10	10	10	10

CENTRAL UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	15	—	—	—	40	20	20	20	—	—	—
ARGENTINA	10	15	20/40	20/40	—	—	—	—	—	—	15	10
AUSTRALIA	15	15	15	20	20/40	20/40	20	20	—	—	15	—
CANAL ZONE	15	20	20/40	20/40	20/40	20	20	20	15	10	10	10
ENGLAND	—	—	—	—	—	—	20	15	10	15	20	—
HAWAII	15	15	15	20	20/40	20/40	—	—	20	—	—	15
INDIA	15	20*	20	20	—	—	—	—	—	—	—	—
JAPAN	15	15	—	—	—	40	20	20	20	—	—	—
MEXICO	15	20	20/40	20/40	20/40	20	20	20	15	10	10	10
PHILIPPINES	15	—	20(1)	20(1)	—	—	20	20	15	15	—	—
PUERTO RICO	15	20	20/40	20/40	20/40	20	20	20	15	10	10	10
SOUTH AFRICA	—	—	40	20	—	—	—	—	15	20	—	—
U.S.S.R.	—	—	—	—	—	—	—	—	—	20	20	—

WESTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	—	—	20	20	20	20/40	—	20	15	—	15
ARGENTINA	10	15	15	15	20	—	20	20	—	—	—	10
AUSTRALIA	10	10	15	15	20	20	40/80	20	20	—	—	—
CANAL ZONE	15	15	20/40	20/40	20/40	20	—	15	—	—	10	10
ENGLAND	—	—	—	—	—	—	—	—	20	15	20	—
HAWAII	10	15	15	20	20/40	20/40	20	20	—	—	15	10
INDIA	—	—	15	—	—	—	—	20	—	15	—	—
JAPAN	15	—	—	20	20	20	20/40	—	20	15	—	15
MEXICO	15	15	20/40	20/40	20/40	20	—	15	—	—	10	10
PHILIPPINES	—	—	—	—	20	20	20	20*	15	15	—	—
PUERTO RICO	15	15	20/40	20/40	20/40	20	—	15	—	—	10	10
SOUTH AFRICA	—	—	—	20	20	—	—	—	20	15	—	—
U.S.S.R.	—	—	—	—	—	—	—	20	20*	20	—	—
EAST COAST	15	20	40/80	40/80	40/80	40/80	80	20	10	10	10	10

DECEMBER 1989

SUN	MON	TUE	WED	THU	FRI	SAT
					1 G	2 G
3 G	4 F	5 F	6 F-G	7 G	8 G	9 G
10 F	11 F-G	12 G	13 G	14 G	15 G	16 G-F
17 F	18 F-P	19 F-P	20 P	21 P	22 P	23 P
24 P	25 P	26 P-F	27 F	28 F-G	29 G	30 G-F
31 G-F						

Never Say Die

successes—and your failures.

The only way we're ever going to clean up our bands is with your help.

Perhaps you noticed that when you use my call you're going to be nice, not mean. We have more meanness than we need on our bands right now, so kill these rotten scoundrels with niceness. These guys are experts at getting your goat. You'll absolutely ruin their day if you are unflappable.

This shouldn't stop you from pittying their family and friends, who have to put up with them during the few hours a day when they are not spoiling our bands for us.

Plan B, Part II

If you find it heavy going when you try to inject some intelligence into your contacts, I have a shortcut for you. Mark you, this is probably going to be one of the most difficult things you've ever done in amateur radio—worse even than that stupid 1920's code requirement which drove you bananas when you decided to get your ticket.

"Hunting jammers is real fun. It'll give your club some first rate direction finding experience."

I'm asking you right here and now to take a pledge—to sign an oath—make a pact with me. I want you to go to your hamshack right now, draw a line under the last contact in your log and write this:

"I hereby swear that never again, as long as I live, will I ever divulge over the air the manufacturer, model number or any other information about any equipment I'm presently using, plan to use in the future or have used in the past. Further, that includes every aspect of my antenna system, homemade or bought. I also agree that I will not, under any circumstances, discuss today's weather, either here or anywhere else in the world, in anything less than a declared national emergency." Now sign that pledge and start your first day as an evangelical spreader of the gospel of Better Hamming. If anyone pressures you to break your pledged word, just tell 'em you've signed the "W2NSD pledge" and that wild horses, Wouff Hongs or even Rettysnitches (infamous old ham ARRL torture instruments used to beat "rotten QRMers" into either compliance or silent keys) will not change your firm principles.

Would you like to really drive some thoroughly rutted hams absolutely crazy? Have you ever tried *not* giving them a numbered signal report? You see, there's this column in their log for a signal report. "Armchair copy" or "You're coming in pretty good" isn't there. They need a number. I've had some hams plead, reduced to tears, for their signal report.

You've never seen a tougher sonofagun than me. I tell 'em, if they absolutely must put a signal report in their log, why go ahead and make one up. No, they've got to hear it from me, otherwise it's cheating. I smile a wicked, fiendish smile as I taunt them almost beyond endurance. Nothing will force me to give them that treasured number. Yes, I realize that I may occasionally push some Extra Class hams over the edge. They deserve it.

I had a letter from an W4's XYL saying her husband has been unable to make another contact. The unfilled box in his log had brought him to a sudden halt in his hamming, so he'd started helping her with the housework and please, please send him his report so she could get him back into the hamshack and out from under foot.

Figuring that I'd done hamdom a big favor and that it was better for his wife to suffer than hundreds of hams, I refused. I knew I'd get no thanks from any of you for this public service, but it was still worth it.

So go you forth and do likewise. Don't expect any thanks. All you'll get for your trouble is abuse, but when you finally win that last big honor, your ARRL Silent Key Award (many hams are dying to get it), then's when you'll get your reward. If I'm not there already, have patience, I'll be along and pin an ectoplasmic medal on your sheet. Then we'll go down on 20m, call CQDX, sign very rare calls with weak signals and not come back to the DXers. 73

73 INTERNATIONAL

edited by C. C. C.

Notes from FN42

It's that time of year again when we in the Northern Hemisphere start thinking of snow, ice, and winter sports, and those of you in the Southern Hemisphere think of warm weather, sunshine, and summer. I think of the very nice summer we have had in New Hampshire and of all the ham activities that I have been involved in. And now, as I reflect on the end of summer (this was written in September), I wonder how many others around this beautiful Earth of ours have enjoyed theirs as much as I have mine.

But there have been many tragedies as well. Even though the airplane is still the safest means of travel, the number of aircraft accidents appear to be higher this year. Is this because there actually are more accidents, or because of an increased awareness presented by the news media throughout the world? Are there more riots and related deaths or just increased worldwide news releases?

Is communications important? You bet! Whether it is from the news media presenting reports of worldwide significance, satellites providing up-to-the-minute pictures of hurricanes, typhoons, or other weather phenomena, the current cellular telephone craze, or just talking with a friend on the telephone or radio, communications is a very important part of our lives.

Hams have become more and more involved. Even the news media understand the importance of amateur radio communications. In the United States the Federal Communications Commission has been asked to allow the news media to use ham radio operators to gather and send information of a commercial nature in times of emergency.

How many times have hams provided health and welfare communications after hurricanes, earthquakes, and other tragedies? Thousands, at least.

I think it's wonderful to have a hobby that provides so much enjoyment and at the same time provides a much needed service to the world. Keep up the good work, enjoy yourselves, and do great things!

Happy Holidays, and may the beginning of your new year bring prosperity and joy.

ROUNDUP

Brazil SERRA DO CACHIMBO, Brazil (AP)—Plane crash survivors who were stranded in the Amazon jungle for nearly two days said the pilot asked for their forgiveness and wished them luck as their jet crashed into dense vegetation earlier this year.

"We were ready to die, but the hand of God guided our descent," passenger Epaminondas de Sousa Chaves, 36, said after Air Force helicopters airlifted 41 survivors out of the jungle.

The Varig Airlines Boeing 737-200 crashed on a Sunday night, killing at least 10 of the 54 people aboard.

The Air Force found the plane Tuesday night after four survivors walked through the jungle and contacted authorities by ham radio.

[*I wonder how much farther the survivors would have had to walk to get to another form of communication, and how many others might have died before help arrived —CCC*]

Next ITU Plenipotentiary Conference in Japan

Japan From the JARL News. At the Plenipotentiary Conference of the International Telecommunication Union (ITU) held in Nice, France, from May 23 to June 30 this year, it was approved that the next plenipotentiary conference, in 1994, will be held in Tokyo, at the Science and Technology Hall at Kitanomaru Park. This approval will be officially confirmed at the ITU's Board Meeting in 1991.

The most important conference of the ITU will be held for the very first time in the Asia and Oceania area.

Since this is a good opportunity for radio amateurs to have their problems understood by VIPs and leading members of worldwide electronic and communication circles, JARL and all others will work toward making all necessary preparations for a successful conference.

Gallium Arsenide Solar Cell for JAS-1b

JARL has decided to use gallium arsenide solar cells for JAS-1b, the second Japanese amateur satellite to be launched in February 1990. The solar cells were recently delivered from Mitsubishi Electric Co., Ltd.

Compared to silicon solar cells, they are nearly forty percent more efficient in power generation. Production cost is two to three times higher than for silicon solar cells, but because of its greater efficiency, the gallium arsenide solar cell was developed and used in Japanese communication satellite CS-3, already launched by the National Space Development Agency of Japan (NASDA).

JAS-1b uses about 1,300 cells of two different sizes, 1x2 and 2x2 sq. cm. They are expected to generate 11 watts, which is 4.5 watts more than the power for FUJI, although the satellite itself has been enlarged a little bit.

[*The JARL also sent a list of Chinese Amateur Radio Stations with QSL information. Look for it on the 73 BBS (1-603-525-4438). —CCC*]

Lithuania Seeks IARU Membership

Lithuania. News release from Ed Shakalis, KA1QOF. On June 12, 1989 at ARRL headquarters in Newington, Connecticut, a delegation from the "Worldwide Lithuanian Amateur Radio Net" met with Mr. Naoki Akiyama, Assistant to the Secretary for IARU (The International Radio Union), to discuss the LIETUVOS RADIJO MEGEJU DRAUGIJA (Lithuanian Amateur Radio Society) application for membership to IARU.

The Lithuanian group included Messrs. Sakalas Uzdavinys UP2BO from Vilnius, Lithuania, Flavius Jankauskas K3JA, Bronius Uzdavinys KB1PI, and from the USA, Ed Shakalis KA1QOF.

Mr. Akiyama explained in detail the necessary steps to become a member of the IARU. The Lithuanians thanked Mr. Akiyama for his consideration and help in this manner.

Sakalas UP2BO, a radio ham for 41 years, said that an application for membership to the IARU would be initiated by "The Lithuanian Amateur Radio Society" upon his return to Lithuania. He also said that they are working to get back their original call prefix "LY" which they were allowed to use for only one month earlier this year and one month last year.

[*Ed Shakalis KA1QOF, 10 John Alden Road, Plymouth, MA 02360*]

Netherlands. From the Radio Netherlands Programme Information Release (Aug–Nov 1989). For those of you who wish to receive this programme release in electronic form, dial your international access code, then 31 354 5395 to reach our IBM host computer in The Netherlands. It will work at 300/1200/2400 baud. We use the standard 8-N-1 format, and both CCITT and Bell tones. Material is distributed in North America by ANARC on 913 345 1978 (the board recently moved to Kansas) or Pineland NJ on 609 859 1910.

In Britain you can now call the Merkinstead bulletin board in Manchester. The number is 44 61 434 7059. Look for Radio Netherlands material in the "Hilversummary Room." If you run a computer bulletin board and would like an electronic feed of this news, please get in touch. Electronic versions of this news release are

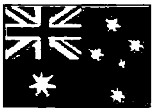
Calendar for December

- **1**—Anniversary Day, Portugal; National Day, Central African Republic (5th for Thailand, 17th for Bhutan)
- **2**—National Holiday, Laos, United Arab Emirates
- **5**—Discovery Day, Haiti; Nicholas Eve, Netherlands
- **6**—Independence Day, Finland (7th for Ivory Coast, 9th for Tanzania, 11th for Upper Volta, 12th for Kenya, 16th for Bahrain)
- **10**—Human Rights Day, Equatorial New Guinea (others)
- **13**—Republic Day, Malta (18th for Niger)
- **15**—Statue Day, Netherlands; Bill of Rights Day, USA
- **16**—Victory Day, Bangladesh (23rd for Egypt)
- **24**—Heiligabend, Germany
- **25**—Christmas Day in many countries
- **26**—Boxing Day, Canada, Great Britain; Day After Christmas (Lendemain de Noel) (Weihnachtstag) (Dia de Aguinaldos)
- **27**—Constitution Day, North Korea
- **28**—King's Birthday, Nepal
- **30**—Anniversary Day, Madagascar; Rizal Day, Philippines

updated.

A new series of QSL cards has been issued by Radio Netherlands to celebrate 25 years of the European Space Agency ESA. The technical centre for ESA is located in Noordwijk, on the Dutch North Sea Coast. Correct reception reports will get one of these new cards. The series is limited, available while stocks last.

Since September 5th, Radio Netherlands has been available in the United States through the C-SPAN "Flagship" audio channel. After initial experiments, the service is now being offered to cable companies across the US. If your cable company offers C-SPAN television, call your local cable operator and ask about the availability of the audio service. At present C-SPAN is picking Radio Netherlands off the air using professional equipment. . . if you can hear this service, tell us whether a studio feed by satellite would improve your listening enjoyment.



AUSTRALIA

Ken Goth VK3AJU
38A Lansdowne Road
St. Kilda, Vic. 3183
Australia

Ken reports that he received news about July 10 that he had won the VK HF Contest Championship for 1988. This is kind of a pentathalon minus one event, based on placings in their four annual HF contests.

The four contests are the John Moyle (emphasis on portable/field ops); the Novice (scores are loaded for low powered and club stations; separate sections for Novice and Full Calls), the Remembrance Day Contest (a sheer numbers game, involving VK, ZL, and P29 to commemorate ops killed in World War II); and finally the VK/ZL/O Contest.

The reward is a small cup—a replica of a larger permanent trophy which remains with the WIA with the names of winners over the years inscribed on it.

The meeting of the WIA Federal Executive in June resulted in plans for a new edition of the VK callbook, a recruitment drive, 80th anniversary celebrations, and a liaison with the federal government. Defeated was a move for a fairly substantial hike in WIA membership fees.

[Ken suffered a medical setback at the end of 1988, but is recovering well. He shed many responsibilities, but will continue as WIA Awards Manager, 73 Hambassador, and, of course, contesting.—CCC]

ISRAEL

Ron Gang 4X1MK
Kibbutz Urim
Negev M.P.O. 85530
Israel

Crusader Fortresses Operation

For 100 hours, four stations operated concurrently (some of them multi-rig at): 4Z1A from the Crusader ruins in the Ashkelon National Park; 4Z2B at the reconstructed Belvoir fortress overlooking the southern Sea of Galilee and Jordan River; 4Z3C in the ruined Crusader port and stronghold of Caesarea on the northern coast of the Mediterranean; and 4Z5Y at Yehiam in the Galilee, the site of the Judyn Crusader fort. 55,000 contacts were made by the stations, operating around the clock under exceedingly good band conditions at this sunspot cycle high.

A very handsome award is available to those contacting all four stations. All one has to do is to send a written request for the certificate along with an excerpt from your log showing the details of the QSOs with each of the four stations, and a handling charge of either 7 IRCs or $5.00 US (do not send checks) to: Crusader Award, Israel Amateur Radio Club, POB 4099, 61040 Tel-Aviv, Israel.

QSL cards are being sent for each contact made through the QSL bureaus around the world, so every contact will be confirmed. The organizers of the event request that hams do not send QSLs and postage-accompanied requests for direct replies, since with the great volume of contacts these special requests cannot be accommodated.

Unofficial Report from Hungary

Ahron 4X1AT has just returned from a motor trip through Europe, and has interesting news. Although Israel does not have a reciprocal licensing agreement with Hungary, and to the best of our knowledge not many countries do, he was granted permission to operate his mobile station there! He returns home with the as yet unofficial good tidings that radio hams from around the world, bringing with them a letter from their national radio society attesting to their being an amateur of good standing, along with a copy of their license, will be allowed to operate there. Ahron says that he was received most cordially at the border, and the officials did not even beat an eyelash at the sight of his whip antenna on the car and radio gear. Apparently, the same warm welcome mat is put out to radio amateurs visiting Hungary from all over the world.

I'm sorry to say that the above information is sketchy, and hopefully someone from the Hungarian Amateur Radio Federation will be able to supply *73 International* with the complete details.

From Ahron: "Hungary is a beautiful country to visit, and during July, I worked ON6UG/HA on AMSAT OSCAR 13. Freddie was operating from a campground 45 kilometers west of Budapest, and his 2 meter, 70 and 22 centimeter antenna was a homemade ten-foot dish, putting excellent signals into the satellite. If this Eastern Bloc country will allow foreign nationals to operate such suspicious-looking gear on their territory, it would definitely point to the dawning of a new age of enlightenment with the relaxing of international tensions."

In Hungary there are two license classes—the HA prefix with full privileges on all the bands, and the HG prefix, apparently restricted to VHF and UHF operation. Ahron says that the responsibility for amateur licensing is apparently now in the hands of the newly reorganized Hungarian Amateur Radio Federation, and not the government. Anybody out there who can set the record straight?

The 1989 Annual Membership Assembly

In late May, in accordance with the IARC bylaws, the club members were assembled to express themselves and elect a new slate of officers for a year's term. As always, a major motive for the hundreds of hams from around the country to come is the social aspect—to meet face to face the physical entities from whom the voices, and the words on the packet-fed computer screens, emanate.

The place—a large auditorium in the Tel Aviv University, home of the world-renowned 4X6TU beacon on 14.100 MHz. Shlomo 4X6LM was elected to chair the meeting. He invited Yankele 4X4AH, IARC president, to the podium for his words of greeting to all, and praise of IARC achievements in the past year. Israel Biber 4X1OR, speaking on behalf of the Communications Ministry, praised the participation of the radio amateurs in the Israeli aid mission to earthquake-striken Armenia. Israel told us that a new syllabus for the Grade "A" license exams had been approved and that a reciprocal licensing agreement had been signed between Denmark and Israel.

Awards: Jim 4X1RU was acclaimed outstanding amateur of the year for his operation of his packet BBS/Gateway station that serves as an important junction on the crossroads of Europe, Asia and Africa, with hundreds of messages being cleared through his station.

Hardy 4X6VH was named for his work as an instructor at 4X4HF, the Bet Miller Radio Club in Haifa, and his handling of the huge volume of QSL cards for the IARC QSL bureau. Avner 4X1GE was cited for his excellent series of technical articles in *HaGal*, the IARC magazine, articles which no amateur radio publication in the world would be ashamed to print.

Ralph 4X1IF's outstanding accomplishments in moonbounce were awarded, and Shoshana and Ahron, 4X6OL and 4X1AT, were granted the recognition due them for their successes in bringing scores of people to earning their amateur radio licenses.

Ahron 4X1AT, stepping down as IARC general secretary, recalled the Passover operation putting four stations on the air from Crusader forts for 100 hours, and said that work continues in getting Israel into the European Common License Group. Yossi 4X6KJ said that in the past year membership services greatly expanded. Michael 4X6PZ, who was the IARC liaison person with the Communications Ministry, reported that no more repeaters were being authorized on the 70 cm UHF band, as this slice of spectrum was indispensible to other services. Authorization of autopatches on the repeaters still remains a problem, but on the brighter side the Grade "A" syllabus he had initiated had been

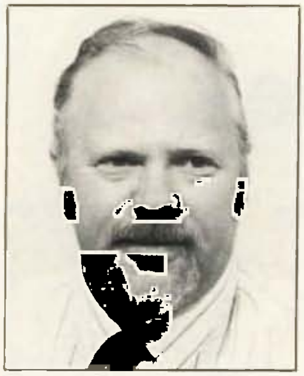


Photo A. Peter Strauss ZS6ET, IARU Liaison Officer, SARL, and 73 Hambassador

authorized, and he had worked with the "Open University" on a course to prepare hopefuls for the Grade "B" examinations. Kuti 4X6OM, treasurer, gave the financial report, and Aharon 4X6SF reported on the year's special events. Moshe Laufman, IARC spokesman, said that Israel Television would be producing a documentary on amateur radio.

After the intermission for refreshments and general ragchewing, the meeting reconvened with the traditional open forum for IARC members to express their ideas and opinions. Then the serious business of electing a new executive, formed by 4X1IO, 4Z4's BQ, PE and ZB, 4X6's KJ, OM, PZ, SF and YA. Comptroller committee is 4X1FU, 4X4ND and 4Z4JT, and membership committee is 4X6LD, 4X6AS and 4X4ML. 4X6KJ's proposal for constitutional reform was passed to a legal committee that will present an amendment for next year's general assembly to vote on.

IARC New Executive Goes to Work

On the 9th of July the outgoing and incoming executives got together to hand over portfolios, and these are the new officers' positions: 4X6KJ, general secretary; 4X6PZ, second in charge and liaison to Communications Ministry; 4X6YA, secretary; 4Z4BQ, assistant secretary; 4X6SF and 4Z4ZB, special events; 4Z4PE, repeaters; and 4X1IO, packet and digipeater coordinator.

4X1FU—DXer of Distinction

Yitzhak Halfon 4X1FU has served and continues to serve with the IARC incoming QSL bureau, and his DX bulletins are available on the packet network. Now the news comes to us that Yitzhak has made the Five Band DXCC, and is also on the DXCC Honor Roll. Hat's off for your persistence, that has paid off in these marks of distinction!

Rishon Hams Meet Weekly

Joining the tradition of weekly get-togethers of radio amateurs in the larger urban centers, the hams of Rishon Le'Tzion now meet Friday afternoons at a sidewalk cafe at the Rishon Mall. Recently, the mayor passed by the 17 hams sitting there, struck up a conversation, and ended up inviting them all to his home!

[*How often has that happened to any of you?*]

Dayton in Israel?

Israel's first real hamfest was held on the 18th of October in Natanya, a good place convenient for most amateurs. Organizers of this event were 4X6TQ, 4X1KT and 4X6KF.

[*This was written in September. Hopefully it went well.—CCC*]

Dataspace 1989

Representing Israeli hams at Dataspace 1989 at the University of Surrey in England from July 27 through 31 were Shlomo 4X1AS and Yair 4X4GI. Yair wrote a comprehensive article explaining the intricacies of AMSAT Phase III in the IARC publication seven years ago, and in 1984–5 gave a fortnightly series of lectures for amateurs on amateur satellites, in what was then the AMSAT-Israel chapter. Many of us who have since gone into this most exciting mode of communications will be waiting for their report of the conference.

SOUTH AFRICA

Peter Strauss ZS6ET
P.O. Box 35461
Northcliff 2115
South Africa

Peter reports through a note from SARL Headquarters that extracts of the SARL HQ bulletin will be airmailed to many publications. Local news items will be deleted. Should you require such news on magnetic media (IBM 360kB 48 TPI PC/XT) or via packet (your national licence conditions permitting), please advise the SARL IARU desk.

At present, co-ordinators for German, Portuguese, Scandinavian, French, Dutch, Spanish, Italian and Arabic languages have been or will be appointed.

The South African Radio League actively promotes the issue of temporary licences for foreign radio amateurs intending to visit the Republic of South Africa and the general liberalisation of licencing of visiting foreign radio amateurs worldwide. Since 1981 the licence authority in Pretoria issues short-term licences to applicants for a nominal fee of only Rand 12 (approx. US $5) for a three-month period. Amateurs from countries whose administrations conclude a bilateral agreement with South Africa receive such permit free of charge. Guest licences may be issued to applicants from any country, and have indeed been issued to visitors from many countries already.

If the administration in your country issues a guest licence only based on bilateral agreements, and no agreement as yet has been concluded with the administration in the Republic of South Africa, you are cordially invited to contact the SARL HQ to discuss preliminaries to such an agreement.

The administration of the Republic of South Africa has concluded bilateral agreements with the following list of countries: Bophuthatswana, Botswana, Chile, Ciskei, German Federal Rep. (including West Berlin), Great Britain, Israel, Portugal, South West Africa/Namibia, Swaziland, Switzerland, Transkei, Venda, United States of America, and Zimbabwe.

Foreign amateurs should, however, note that the South African licence authority will consider applications for a short-term permit from any amateur in any country holding a CEPT Class 1 or CEPT Class 2 compatible licence. Amateurs holding only a Novice grade licence may not be issued with a short-term permit, as there is no compatible licence grade available in South Africa.

New address for the SARL is: South African Radio League Headquarters, PO Box 2327, Johannesburg 2000, South Africa. Tel: (011) 484-2830. 73

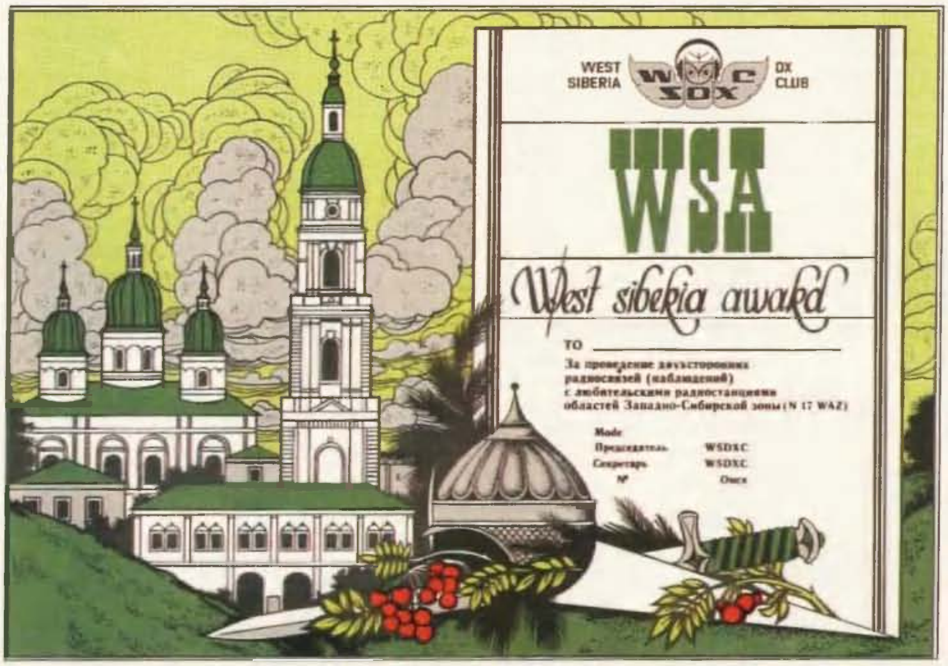


Photo B. WSA West Siberia Award from the West Siberia DX Club, sent by UA9MA.

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. . . de K6MH

Amateur, from Latin amare, to love. One who engages in activity for the beauty of it.

Amateurity

I'm wary of the word "amateurish." It's a put-down I dislike, as if "amateur" means "immature" and where it's really at is to be "professional." The word "professional" has been given lots of moxie compared to "amateur" and I question this.

An amateur is a person who does something for the love of it, for the intrinsic value of it, the adventure, the discovery, the hope of presenting something new or useful to others. Amateurs are not motivated primarily by the desire to serve their fellow beings, but it often turns out that way. Why? Because something done for the beauty of it makes good waves.

What bothers me is all the efforts going on in the world that are not amateurish, but what we might call "professionalish." Professionalism dates back to the oldest profession (remember that one?), and pros have been with us ever since.*

Think it over. Where have the great advances come from? Amateurs. And who is busy at work destroying the planet, from the rape of the rain forests to the pollution of air, water, and soil? Professionals, people who are *over*employed doing something they don't like, don't feel really good about, because they think they must.

It's been said, The world is for lovers. Is it so? Loveless, non-amateur acts are about to do us in. Maybe we should look again to the beauty of what we do, rather than to the means of exploiting it for the almighty buck. I say we need more amateurs . . . and more amateurity among the professionals.

By definition, children are amateurs, amateurs who society makes every effort to professionalize. We may need more unconverted amateurs, children allowed to grow up following their curiosity, being "a light unto themselves," rather than being "whipped into shape."

The word *amateurity* has entrenched itself in my vocabulary. It's yours to use if you like. To me it means real maturity, a love of action for its own sake not only in youth but in the full-grown human who has not lost this love, this amateur spirit, or has lost it for a time, but thank God, regained it.

WW III

Hams are famous for coming through in emergencies. What we fail to realize is that we are embroiled right now in the greatest emergency mankind has ever known: wholesale extinction of species, destruction of the subtle web of support from plankton through myriads of flora and fauna all the way up to us "higher types," an interdependent design that works well only when none of the parts are missing.

World War III is already happening. It's a war worth fighting, a global war against *ignore-ance*, a war that none of us can escape.

From lesser emergencies in the past we have learned this: Without communication we are lost. . . . de K6MH

*I've heard since that the oldest profession is shamanism, but I couldn't resist the dig.

How About . . .

. . . An Instantaneous Direction Finder for transmitter hunting? One that uses a phased array switched electronically, to give a reading in less than a second, with no physical rotation needed?

. . . A unisex word for "he/she," "him/her?"

. . . Educational amateur radio, a way to participate in lifelong learning for young and old, shut-ins and travelers, via 2m repeater nets?

. . . Sharing who's behind the Wizard-of-Oz cabinet, instead of cataloging what the cabinet consists of (rig, antenna, etc.)?

. . . More ideas from you, the reader, for future "How About's."